THE
METAL INDUSTRY

WITH WHICH ARE INCORPORATED
THE ALUMINUM WORLD: COPPER AND BRASS: THE BRASS FOUNDER AND FINISHER
ELECTRO-PLATERS REVIEW

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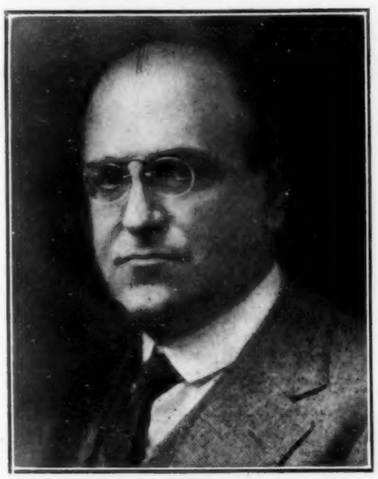
Institute of Metals Division Meets in Cleveland

A Report of the Session Held and Exhibits in Conjunction with the National Metal Congress, September 9-13, 1929

THE National Metal Congress was held in Cleveland, Ohio, September 9-13, 1929. This was a co-operative undertaking of the American Society for Steel Treating, the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers, American Welding Society, Iron and Steel Division of the American Society of Mechanical Engineers and the Iron and Steel Division, A. I. M. E.

A prominent place at the meeting was taken by non-ferrous metals. Aluminum was exhibited in comprehensive fashion showing castings made in sand, dies and permanent molds; also rolled, forged, and otherwise fabricated aluminum.

Zinc was shown in rolled form and in die castings.



S. SKOWRONSKI
Chairman, Institute of Metals Division

A list of the exhibitors, specialists in non-ferrous metals, is given below:

Abrasive Company, Philadelphia, Pa. Snagging wheels.

Air Reduction Sales Company, New York. Oxy-acetylene welding and cutting equipment.

Ajax Electrothermic Corporation, Trenton, N. J. High frequency induction furnaces.

Aluminum Company of America, Pittsburgh, Pa. Aluminum in all forms.

American Brass Company, Waterbury, Conn. Special alloys and welding methods.

American Gas Furnace Company, Elizabeth, N. J. Melting and heat treating furnaces.

Armstrong Cork and Insulation Company, Lancaster, Pa. Insulating brick.

Bellevue Industrial Furnace Company, Detroit, Mich. Electric furnaces for heat treating metals.

Botfield Refractories Company, Philadelphia, Pa. Fire brick cement.

Calorizing Company, Pittsburgh, Pa. Calorized parts.

Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn. Industrial washing machines.

General Electric Company, Schenectady, N. Y. Heat treating furnaces and welding equipment.

International Nickel Company, New York. Nickel in all forms.

Charles F. Kenworthy, Inc., Waterbury, Conn. Annealing furnaces.

Lava Crucible Company, Pittsburgh, Pa. Super-refractories in standard and special shapes; graphite crucibles.

E. J. Lavino and Company, Philadelphia, Pa. Special refractories and chrome ores.

Milwaukee Die Casting Company, Milwaukee, Wis. Die castings in all forms.

New Jersey Zinc Company, New York. Zinc in all forms.

Norton Company, Worcester, Mass. High speed grinding equipment and abrasive products.

Roessler and Hasslacher Chemical Company, New York. Chemicals used in hardening and heat treating steel, and electroplating.

A dinner was held on Tuesday, September 10th, at 6:30 P. M., at the Hotel Cleveland, of the Institute of Metals Division and the Iron and Steel Division, A. I. M. E. The speakers at this dinner were F. T. Taylor, vice-president of the Hanson Van Winkle-Muning Company, New York, and Dr. H. W. Gillett, director, Batelle Memorial Institute, Columbus, Ohio.

Address by F. T. Taylor

Mr. Taylor briefly traced the history of electroplating from the discovery in 1833 by Michael Faraday of the laws of electrolysis. He described the different uses to which electroplated coatings are put, mentioning electroforming (such as electrotyping); the manufacture of extremely thin foils more cheaply by electroplating than

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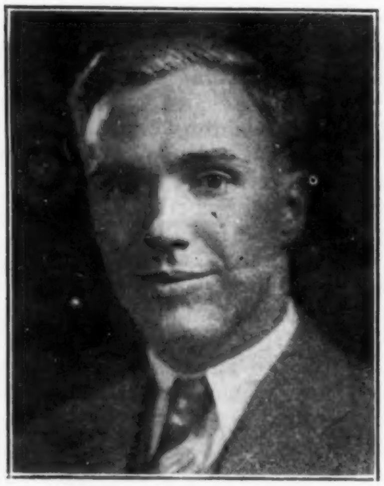

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by rolling (such as nickel flakes of the Edison storage battery); the protection against corrosion; and the bright, attractive, highly polished finishes.

Mr. Taylor described the great growth in electroplating since the war. Copper plating now takes about 500 tons of metal annually; nickel, 2,000 to 3,000 tons; zinc, more than 10,000 tons; cadmium, about 650 tons. About 17 per cent of the entire output of silver for industrial uses goes into silver plated ware.

The tendency in electroplating, according to Mr. Taylor, is to advance from the control of a skilled foreman to the supervision of the plant chemist, and the possibilities are that the metallurgist, who is responsible for the surface conditions of the base metal used, will be called in to help solve plating problems of the future.

A special plant visit was made by the Institute of Metals Division to the Nela Park and Pitney Company glass works of the General Electric Company.

Abstracts of the papers delivered at the sessions of the Institute of Metals Division are given below:

NOTE ON THE CRYSTAL STRUCTURE OF THE ALPHA COPPER-TIN ALLOYS

By Robert F. Mehl and Charles S. Barrett

The side of the unit face-centered cube and the density were determined for three alloy compositions in the alpha field of the copper-tin system. It is shown contrary to previously published work, that this solid solution is simple substitutional in type.

EFFECT OF ALLOYING ON THE PERMISSIBLE FIBER STRESS IN CORRUGATED ZINC ROOFING

By E. A. Anderson

An alloy of zinc containing 1 per cent of copper and 0.01 per cent of magnesium has been studied.

The tensile strength of the rolled alloy as compared with the tensile strength of the rolled unalloyed base is 35,000 to 60,000 lb. per sq. in. as against 20,000 to 30,000 lb. per sq. in. The alloy is also much tougher at freezing temperatures.

The apparent elastic limit determined by the Johnson method is above 13,500 lb. per sq. in. with the grain as compared with 5,200 lb. per sq. in. for the unalloyed base.

Loading tests on roof sections confirmed by roof installations show that the higher apparent elastic limit makes it possible to utilize these sheets for roofing on much greater purlin spacings than those safe for ordinary zinc; reaching, in fact, a large range of the spacings used for steel sheets.

THE SYSTEM CADMIUM-MERCURY

By Robert F. Mehl and Charles S. Barrett

1. The crystal structure of mercury at —46° was determined and found to be simple rhombohedral, in agreement with previous determinations at lower temperatures.

2. The crystal structure of mercury-rich cadmium-mercury alloys was determined. The data obtained indicate a new rhombohedral solid solution terminal to pure mercury and a heterogeneous field separating the rhombohedral solid solution from the face-centered tetragonal previously discovered.

3. Heating and cooling curves were taken on the mercury-rich alloys and interpreted to indicate a peritectic reaction near the mercury ordinate of the constitutional diagram. The solid solution terminal to pure mercury probably extends to 3.5 atomic per cent cadmium, the heterogeneous field from 3.5 to 12 atomic per cent cadmium, and the intermediate solid solution field from 12 atomic per cent cadmium to higher concentrations in cadmium.

4. A new transition point was found in the intermediate solid solution field. It is characterized only by a change in specific heat, not accompanied by any other thermal change and not accompanied by a change in crystal structure.

DEOXIDATION OF COPPER WITH CALCIUM AND PROPERTIES OF SOME COPPER-CALCIUM ALLOYS

By Earle E. Schumacher, W. C. Ellis and John F. Eckel

1. Small additions of calcium in copper effectively deoxidize the metal without materially impairing the mechanical properties and electrical conductivity, provided the residual calcium is kept to a small percentage.

2. The deoxidation of two laboratory melts of copper with calcium resulted in material of high conductivity and good mechanical properties which was not embrittled by annealing in reducing gases. These results indicate the possibility of producing deoxidized copper of high conductivity by this method, provided the oxygen content of the melt prior to the deoxidation is known within reasonable limits.

THE EUTECTIC COMPOSITION OF COPPER AND TIN

By G. O. Hiers and G. P. de Forest

This paper presents evidence from dissolution experiments, cooling curves, and micrographic examination of copper-tin alloys in the region of 1 per cent copper indicating that the eutectic is at 0.94 per cent Cu. The methods, apparatus, and polishing technique used are described and photomicrographs shown.

DETERMINING ORIENTATION OF CRYSTALS IN ROLLED METAL FROM X-RAY PATTERNS TAKEN BY MONOCHROMATIC PINHOLE METHOD

By Wheeler P. Davey and C. C. Nitchie and M. L. Fuller

When metals are subjected to mechanical working, such as rolling, one of the phenomena that take place is a movement of the crystals of the metal into a system or systems of orientation which bear an angular relation to the direction of working. In rolled metal the crystals may orient themselves with respect to the rolling plane or the rolling direction, or both.

A method has been devised by one of the authors, which is applicable to orientation studies irrespective of the degree of preference of orientation and which may be used where one preferred orientation, a system of orientations, or even several systems of orientations must be dealt with. Some preliminary results obtained by the use of this method were given by H. B. de Vore and W. P. Davey. It is the purpose of this paper to describe the method fully and to illustrate its use in detail in the case of rolled zinc.

EFFECT OF HEAT TREATMENT ON PROPERTIES AND MICROSTRUCTURE OF BRITANNIA METAL

By B. Egeberg and H. B. Smith

1. When cold-rolled less than 40 to 50 per cent, the metal becomes slightly harder, and it is softened by application of heat. At higher reductions, the metal behaves in a contrary manner, in that it becomes continuously and greatly softened the more it is cold-rolled. When in such a state, application of heat produces an increase in hardness and strength. (For

further details regarding cold rolling to more than 50 per cent see the previous paper by the authors.) Based on photomicrographs, a theory has been advanced for the explanation of this abnormal behavior of Britannia metal.

2. With metal that has been given a considerable cold reduction of more than 50 per cent, after baking there is a slight increase in maximum tensile strength and a considerable increase in the breaking load with corresponding loss in elongation.

3. Bend tests were performed on metal cold-rolled more than 50 per cent, by which the permanent set cold be accurately determined. The baked specimens showed about twice as high an elastic limit as the unbaked specimens.

4. A slight increase in hardness was found after aging in metal cold-rolled more than 50 per cent and in the baked metal.

5. Baking reduces somewhat the ductility of Britannia metal cold-rolled more than 50 per cent, as measured by the Erichsen machine.

THE CAUSES OF CUPPY WIRE

By W. E. Remmers

The defect in wire known as "cuppiness" has appeared and disappeared from time to time but the exact cause of its appearance or disappearance has not heretofore been known definitely. This defect is not limited to one particular metal or alloy but seems to be found at various times in all of the materials that are drawn into wire. Differences of opinion are current among the manufacturers of wire and in the literature, some believing that the source of the trouble lies in segregation in the wire rod of oxides, sulfides, slag, etc.; others that the trouble is created by an unevenness of stress distribution across the section of the wire, usually thought of as being a function of die shape. All of the published work is of a qualitative rather than a quantitative nature. With this in mind, it was deemed advisable to make a study of the shape of the wire-drawing dies, as well as the oxygen content of the copper to be drawn.

The method of examining a tension break in wire was found to be the most sensitive in detecting cuppiness. Among the various conditions studied were straight-sided and curved die contours, amount of reduction per die, the effect of a lubricant, relieved dies, and oxygen content of the copper. Copper rod of the following oxygen contents was used: 0.019, 0.042, 0.139 per cent. The 0.042 per cent oxygen rod is representative of the usual oxygen content of copper wire, the other two are considered extremes. The author concludes that there is a definite relationship between the die angle and oxygen content of copper wire rod, which determines whether or not the rod can be drawn into good or cuppy wire. This relationship can be altered by various factors, smooth-curve contour dies and large reductions per die acting to give a better product while relieved dies, reversals of drawing direction and many reductions tend to make a product of lower quality.

Secondary Metals Symposium

By T. A. WRIGHT

Lucius Pitkin, Inc., New York

That the subject of secondary metals from the reclaiming and metallurgical viewpoint is an interesting one to the Institute of Metals was well exemplified by the first session of the three-day program in connection with the National Metal Congress and held at the Hotel Cleveland. At one time one hundred and ten members and visitors were in attendance at this session which was devoted chiefly to secondary metals.

MANUFACTURE OF WIRE BARS FROM SECONDARY COPPER

By W. A. Scheuch and J. Walter Scott

Four years of experience have resulted in the assurance that wire bars of present commercial electrolytic quality can be made by converting secondary copper in a suitable reverberatory furnace. It is true, however, that the secondary copper must be selected carefully and impurities kept out of the final product largely through the careful control of the input. Whether or not it is economical to recover secondary copper as wire bars depends on the amount of selected scrap available, the cost of the scrap, the market for the wire bars, and the relation of the proposed location of the installation to both the source of the secondary copper and the market for the wire bars produced.

The paper was read by Mr. Scott, who stressed five points of particular importance: the use of clean and carefully classified scrap copper; good furnace construction, both as to form and type of refractory; the necessity for close analytical control of the lead, the greater part of which must be removed by close control of the oxidation; and also the first and foremost requirement that of careful choice of the wire, scrap, etc., charged into the furnace.

In the absence of A. T. March, of the Western Electric Company, Stanislaus Skowronski, chairman of the Institute of Metals Division, read a written discussion prepared by Mr. March in which he mentioned that the wire bars produced by the process described compared favorably in rolling and drawing properties with wire bars received from the electrolytic refineries. A discussion on this paper had to be curtailed and was taken up later on, the session extending into the noon-hour.

RECLAIMING NON-FERROUS SCRAP METALS AT MANUFACTURING PLANTS

By Francis N. Flynn

The manufacturing plants referred to in this paper are those of the automobile industry. The paper by its nature defines abstracting, especially the two-page table in which scrap is classified and the methods of its reclaiming and final disposition are indicated. The last two pages are devoted to a discussion of the cupola smelting of scrap. The author recommends a brick-lined cupola as less time is required to warm up the furnace, a campaign can last a shift instead of a week, and the metal can be made lower in iron.

The paper was read by E. R. Darby of the Federal Mogul Corporation, Detroit, and vice-chairman of the session. Inasmuch as the paper dealt with the remelting in brick-lined cupola with a resulting product said to be of exceptional purity there was considerable discussion on that feature alone.

Albert T. March had a written discussion, which was reviewed by Mr. Scheuch, dealing with the matter of the proper precautions advisable in sorting various materials described, and in preventing unnecessary contamination.

The question of the method of separation of babbitt chips from the bronze backing aroused much interest, and that of R. W. Drier, of the Michigan College of Mining & Technology, was particularly pertinent, having to do with certain methods used in their laboratories. Mr. Drier stated that they had experimented with flotation and had had fair results with the electrostatic process.

UTILIZATION OF SECONDARY METALS IN THE RED BRASS FOUNDRY

By H. M. St. John

It is no longer assumed that quality castings must be made from primary metal but when secondary metal is used it must be carefully controlled as to melting and pouring conditions. There are a number of reasons why the foundry department is in the best possible position to make a maximum use of foundry materials. Secondary copper, lead and zinc are extensively used by red brass foundries. The author discusses the selection of the scrap available, the purchase of composition ingot, selection and treatment of turnings and borings, utilization of composition castings and wrought metal, treatment of light and small scrap, ingot making in the foundry, and refining in the electric furnace.

In the absence of the author, the paper was presented by Verne Skillman of the Bohn Aluminum & Brass Company. W. R. Graham read his own written discussion of this paper, and the author's reply to Mr. Graham's objection to the use of the term "secondary" in describing scrap materials was also read by Mr. Skillman.

The chairman, T. A. Wright, of Lucius Pitkin, Inc., mildly suggested that the term "junkman" should not be used, as "junk" in his opinion was material of no value. In opening the meeting, the chairman had called attention to the large importance of secondary metals in our economic system: the values in 1928, according to the official figures of the Department of Commerce recently released, being $277,623,500 which is over $21,000,000 more than 1927; copper and brass alone accounting for $164,000,000. It was also brought out that the "waste material dealer" of the present is a far cry from the "junkman" with his little wagon and bigger bells.

No satisfactory conclusion was arrived at as to the distinction between secondary metal in general and scrap metal, both the terms "tertiary metal" and "reclaimable metal" were offered for regular scrap.

RECOVERY OF WASTE FROM TIN-BASE BABBITTING OPERATION

By P. J. Potter

The author divides the different kinds of scrap into ten grades and outlines the procedure for each grade. They differ materially, according to their nature.

Mr. Potter called attention briefly to methods found to be of particular value in handling scrap from the manufacture of babbitt bearings.

During the general discussion on all the papers that had been presented, some pertinent remarks relative to the necessity of conserving secondary metals, particularly those such as tin and antimony of which we have not a native supply, were made by Major A. H. Hobley of the Office of the Assistant Secretary of War.

Major Hobley stated that the War Department was keenly interested in the entire subject of secondary metals and reclaiming and that he had followed the papers and resultant comment with considerable interest as this was a question of paramount importance to the national defense in times of emergency.

Removing Hardened Brazing Flux

Q.—Will you kindly give me what available information you may have relative to the following:

In brazing with acetylene, using borax, the borax runs on the iron casting, forming a coating like glass. Many methods have been tried to prevent this, but it seems impossible to clean it off.

After painting the iron, the place where the borax was appears all fluffed up, having the appearance of frost.

A.—The glassy coating on iron castings from a brazing flux composed of borax can readily be removed by applying an emery or polishing wheel.

As there is generally a rough surface where the parts or castings have been welded or brazed, it is customary to grind or polish this surface and remove the glassy flux at the same time.

If it is a large casting, flexible revolving wheels can be used; small castings can be handled rapidly on stationary wheels.

—P. W. Blair.

Battery Plates

Q.—I would like to have your opinions on two questions:

What is the average length of service of an automobile storage battery, or how long does it take to reach the junk pile?

What estimate have you of the present monthly tonnage of old battery plates?

A.—The average automobile battery lasts from 18 months to two years.

What proportion of worn out batteries are salvaged is a matter of speculation, but the percentage is probably high (85 to 90 per cent). As an estimate, we would say that in the neighborhood of ten million batteries are junked each year in the United States and that the secondary refiner receives from 5,000 to 10,000 tons of old battery plates per month from this source.

—H. M. St. John.

Bright Finish for Copper Gutters

Q.—We are having a lot of trouble in getting a bright shine on our copper gutters. Before finishing we bright anneal, pickle in sulphuric acid and dry out through a dry roll. After the gutters stand a day or two the finish tarnishes and turns brown. We would appreciate any means you can suggest of preventing the tarnishing.

A.—The cause of the rapid discoloration of the sheet copper after annealing is probably due to lack of proper rinsing in clean, fresh water after the pickling operation.

There should be a plentiful supply of running water and the sheets should be thoroughly rinsed to remove every trace of acid. As the pickle does not fully remove the oxide of copper, the oxide scum should be removed by brushing or swabbing while the sheets are in the water tank. Then dry quickly and thoroughly to prevent spotting and coat with a thin film of vaseline to prevent air oxidation.

We would suggest that it might be more desirable to purchase copper of the right degree of hardness for forming for this purpose. Only cornice work with its sharp angles should require annealing during fabrication.

—Walter Fraine.

The Fundamentals of Brass Foundry Practice

A Description of the Basic Laws Which Control the Melting and Casting of Metals and Their Application to Practical Foundry Work—Part 22*

By R. R. CLARKE
Foundry Superintendent

WRITTEN ESPECIALLY FOR THE METAL INDUSTRY

WITH respect to gate location the rule will well stand repeating that the point at which the gate will best subserve the clean, safe running and feeding of the casting is the logical selection for delivery. If this running and feeding can as well be accomplished from the same runner and sprue gate, the advantage is so to manipulate. If not, then gating for running with one gate and gating for feeding with another gate becomes the more rational practice.

The form and volume of a gate reverts constitutionally to the nature of the casting to be run and fed. Many times we want a gate to fill to the top of the sprue instantaneously and maintain a rapid compact metal current through it, or we may desire the gate to set in its delivering zone at once upon pouring finish. In such and similar objectives the gate must be more on the greater surface—lesser volume principle of construction as in broad thin gates. On the other hand many occasions develop where the gate must maintain a feeding fluidity up to the casting setting. It is then that we must reverse the order and construct on the maximum volume, minimum surface gate. Now as previously pointed out the greatest volume to surface gate is the cylindrical or round form of gate. Of straight line gate forms, that in which the dimensions of the gate section are equal (as in a square gate, 2 inches x 2 inches as against a gate 1 inch x 4 inches) is the maximum of bulk. Round or half round gates are, therefore, the most logical feeders while for practical purposes, square or equilateral triangular gates excel in the rectilinear forms of gate.

As noted in an earlier chapter, gate feeding derives in part from perpetuating metal fluidity. Fluidity depends upon cutting down radiation, radiation depends upon bulk and bulk reverts to the ratio of volume to surface. At this point we might again submit illustrating examples.

A 1⅛" round gate, 1" long contains 1 cubic inch of metal and 5½ square inches of surface. A 1" square gate contains 1 cubic inch of metal and 6 square inches of surface. A ½" thick by 2" wide gate contains 1 cubic inch of metal and 10 square inches of surface. It is thus seen that the round gate is bulkiest, the equal dimension rectilinear gate, the next bulkiest, and the unequal rectilinear least bulky of all. The molder will find this general principle quite valuable in making up his gate form and volume for feeding purposes. The same principles prevail in risers, feeders, etc.

On the form, volume and placement of gates, much might be said in detail. Briefly, the form should be in keeping with the requirements of the casting at hand with respect to its clean and most advantageous delivery of metal. The volume should differentiate similarly and vary further with the conditions as regards feeding, slow or rapid delivery, choking or non-choking requirements, etc. The placement of the gate must revert to the safe and least destructive point of delivery, to the capabilities of running the casting and to the question of its feeding, when deriving from the ingress gate supply. In connection with this three-phase consideration of gating, namely, form, volume and placement the following suggestions are offered.

Gate Form

Gates are of many types and forms: surface gate, underflow or horn gate, drop gate, round gate, half-round, square gate, triangular gate, etc. Each has a field and should be used when the advantage requires it.

Surface gates should not be used to deliver metal to a deep drop in the mold. Surface gates should be free of bumps and hollows, though not of glazed surfaces, too smooth.

All gates connecting with a mold should represent a slightly diminishing size and volume from source to mouth, i.e., from the pouring sprue head to the point of mold delivery.

Runner gates, delivery gates, etc., should represent a minimum of square corners, abrupt contours, etc. A sharp-cornered, square-pouring sprue or drop gate invites a dirty casting.

Button gates are used to absorb the shock of dropping metal and to form a dropping pool of metal in protection of the sand surface dropped upon. They should be cut on a radius slightly larger than the drop sprue. They underlie and represent a soft basin of sand in the best of condition.

Horn gates are used for under-mold delivery or to reach some point of delivery not otherwise accessible. They should embody an easy disengaging curvature and draft and safely underlie the pattern mold. The horn gate delivers metal violently under heavy pouring pressure and should not be used where the spouting effect of metal through it engages the cope surface or any other exposed surface of the mold. To overcome, use a different design of under delivery, or set the pouring sprue off to the side of the horn gate with a choking gate between them.

Horn gates are sometimes used reversed, i.e., heavy end in the mold, light end to the pouring sprue. The practice is a violation of principle in that the gate metal volume diminishes from mouth to source when it should increase. Besides it places a heavy volume of gate metal unsupported directly under the casting and thus favors a draw of metal in the gate from the casting.

Skim gates of the surface variety should be cut broad and then so sized that only clean metal can pass through them. They should always choke the current to the extent of allowing the pouring sprue to be kept level full throughout pouring.

The centrifugal type of skim gate should be so con-

*All rights reserved. This series will be collected and published in book form. Parts 1 to 21, inclusive, were published in our issues of July, August, September, October and November, 1926; January, February, March, April, May, August, September, November, and December, 1927; March, April, May, August, September and December, 1928; March and April, 1929.

structed that the cross runner between pouring sprue and riser should strike the riser at a tangent and thus generate the swirling motion.

For running thin castings, the surface skim gate should be set so that the thin and skimming gate section is close to the casting. For running and feeding heavier castings, this skimming section should be further away and discharge into a heavier gate section supported by a feeding riser.

Surface gated castings lying too close to the pouring sprue generally run dirty as do those occurring at the end of a main line straight runner gate.

The cleaner form of runner gate is that which carries past the branch gate or delivery section, allowing the runner gate sweepings to pocket in the runner gate end, and delivering clean metal to the casting through the branch delivery. Runner gates occurring in the cope of the mold or above the point of delivery gate union to the casting, give cleaner castings. They are also better feeders against the pin hole and draw of the gate at this point of union.

The pouring sprue head of any mold should be of that funnel shape and contour as will encompass a hard poured stream from the ladle and direct it without splashing into the sprue.

All feeding risers should enlarge in volume, close to the casting feeding point and exceed in volume the casting freezing point sufficiently to keep the metal fluid and constantly replenished.

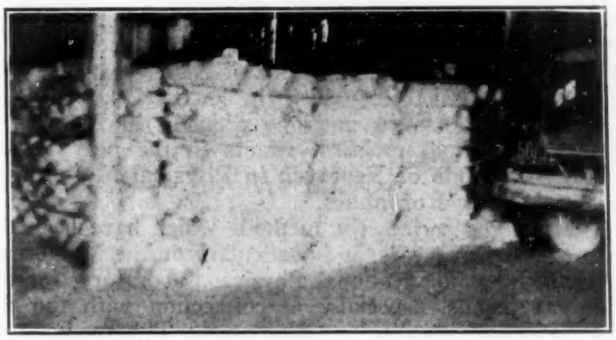
This series will be continued in an early issue.—Ed.

Aluminum Ingots on the Saguenay

The very name Saguenay signifies romance, for it brings to mind the "Voyageurs Canadiens," Indians, trappers, settlers and the rest of the heroes of years ago. And it is natural that on such a romantic stream the romantic metal, aluminum, should be carried back and forth. The accompanying illustration shows a deck-load of aluminum ingots on the steamer "St. Lawrence," one of the fleet of the Canada Steamship Company.

The metal here shown was produced at the plant of Aluminium, Limited, formerly a subsidiary of the Aluminum Company of America. The plant is located at the head of the Saguenay, at the frontier town of Chicoutini. As the large steamers do not go to this port but stop at a town called Bagotville, a short distance away, the metal is loaded on railroad cars at the plant and run across to the docks, where it is placed aboard steamers and shipped to Quebec, Montreal, or any other stopping place of the steamers plying the St. Lawrence and the Great Lakes.

The Saguenay River itself is still without a settlement from its junction with the St. Lawrence to the head of navigation at Bagotville or Chicoutini, but at these two towns civilization has a foothold. Here there are churches and industries. Aluminium, Limited, has established its production plant in this far northern region on account of the water power available there. Consequently, aluminum ingots are a common sight now, being floated



Deck Load of Aluminum Ingots Seen on the Saguenay River

down the Saguenay into the St. Lawrence, then upstream to the Great Lakes or down to the Atlantic for shipment to foreign or American ports.

Continuous Rolling

Q.—Being a subscriber to The Metal Industry, I wish you to give me information in regard to up-to-date builders in the United States of rolling mills for black sheets, their furnace equipment and galvanizing machines. The rolling mills produce black sheets thin enough to be tinned without intermittent heating and rolling as in the old process. The sheet bars are fed in at one side of the furnace, then, after series of rolling operations, the final black sheets come out finished.

I understand that in Chicago some of the tin plate mills produce sheets this way.

A.—We think you have in mind one of the continuous wide strip mills now in operation. The Acme Steel Goods Company, near Chicago, installed the process some time ago. The American Rolling Mill Company has developed this to a point of quantity production and is selling to other mills licenses to use this process.

According to the press, the U. S. Steel Corporation is among the purchasers of this privilege. The Bliss Company of Salem, Ohio, is installing many continuous sheet steel mills.

The two books we know that give the best all-around discussion of this subject are: J. M. Camp and C. B. Francis, "The Making, Shaping and Treating of Steel," 4th edition, page 983, published by the Carnegie Steel Company, Pittsburgh, Pa.; and H. S. Rawdon, "Protective Metallic Coatings," Chapter 8, published by The Chemical Catalogue Company, 419 4th Avenue, New York City. These books may be obtained from the publishers.

We know of no continuous rolling operation that embraces the tinning of sheets.

—W. J. Pettis.

British Institute of Metals Meeting

Synopses of Papers Presented at the Annual Autumn Meeting, Held in Düsseldorf, Germany, September 9-12, 1929

Eighth Autumn Lecture, by Dr. A. G. C. Gwyer, on Aluminium und Seine Legierungen (Aluminum and Its Alloys) (in German).

The Eighth Annual Autumn Lecture, to be delivered to the Institute of Metals at Düsseldorf on September 9, by A. G. C. Gwyer, contains a brief account of some of the more important investigations which have been carried out in recent years upon aluminum and aluminum alloys. Attention is directed to the outstanding characteristics of these alloys, and there is given a short account of recent work that has been done to improve the general reliability of aluminum and its alloys, more particularly from the points of view of soundness and resistance to corrosion. The constitution of the more important aluminum alloys, and of aluminum itself, is described. Of recent years the question of the heat treatment of aluminum alloys has received considerable attention. Therefore a considerable proportion of the lecture is devoted to the subject, which includes, of course, reference to the phenomenon of age-hardening. The lecture concludes with a short account of the application of the methods of X-ray spectrography to aluminum—a subject which the lecturer regards as of very great importance, and one which is likely to yield very valuable and practical results in the near future.

Some Methods of Research in Physical Metallurgy, by Dr. Walter Rosenhain.

The paper describes the methods which have been developed in recent years, and particularly in the Metallurgy Department of the National Physical Laboratory, for the study of metals, especially in connection with the determination of equilibrium diagrams. The methods of determining and recording thermal curves, resistivity—temperature and dilatation—temperature curves, are discussed in detail, and a brief account is given of a novel form of electrical dilatometer, making use of measurements of the capacity of a small condenser which is varied by the dilatation of the specimen. The measurement of this capacity is made by means of oscillatory circuits utilizing thermionic valves, and the resulting graph is plotted by means of an electrical "threadrecorder." Reference is also made to the development of optical pyrometry and a novel method of securing black body conditions, by sighting upon the interior of a gas bubble blown in a mass of molten metal, is described. The applications of the study of structure by means of the microscope and of crystal lattices by means of the X-ray spectrometer are discussed in regard to their bearing upon the equilibrium diagram. Finally, stress is laid upon the importance of securing accurately known composition and the highest possible degree of purity in the metals and alloys used for investigations of this kind. Reference is made to the methods for producing metals of high purity, and the development of special refractories for that purpose, which have been developed at the National Physical Laboratory.

Methods of Research in Metallography, by Dr. G. Masing.

The fundamental principles underlying the methods of research employed in investigations on the constitution of alloys and in physical metallography are discussed, and it is shown that researches on the constitution of alloys must be based on the well-established thermodynamical laws of heterogeneous equilibria. The experimental methods are, however, not sufficient for accurate work and need to be improved in precision and amplified (especially X-ray technique). The most important improvement required is the development of a method for the rapid attainment of equilibrium in an alloy. Besides the establishment of equilibrium diagrams the study of constitution nowadays demands an investigation of the condition of alloys far removed from the state of equilibrium; the theoretical and experimental aspects of this problem are considered.

In physical metallography the greatest interest is evinced in the study of plastic deformation and its attendant phenomena (hardening, recrystallization, etc.). The importance of using precise physical methods in order to make further advances in this field is emphasized.

A Dilatometric Study of Some Univariant Two-Phase Reactions, by P. Chevenard, A. M. Portevin, and X. F. Wache.

The authors have investigated, by means of a dilatometer, the reactions taking place in quenched aluminum-copper and aluminum-silicon alloys, when annealed at various temperatures.

The laws of precipitation during constant temperature annealing, and the influence of temperature on the speed of precipitation, have been studied.

A hitherto unknown reaction has been found and partially elucidated.

Alloys of iron, nickel, and copper have also been investigated by means of the dilatometer, and the boundary of the two-phase field on the iron side of the system has been determined.

An Improved Differential-Dilatometer, by Dr. Max Hass and Dr. Denzo Uno.

The accuracy of Chevenard's optical differential-dilatometer has been improved by mounting the apparatus on a triangular rail, by using one dilatometer tube instead of two, and by replacing the spring that holds the mirror by a magnet coil arrangement. Provision is also made for working in any special atmosphere, and for sketching purposes.

The Open-Air Corrosion of Copper. A chemical study of the surface patina, by W. H. J. Vernon and L. Whitby.

The patina on copper after prolonged exposure to the open air has been studied, samples having been taken from copper structures in urban, rural and coastal districts, respectively. Provided the exposure has been sufficiently prolonged, and in the absence of certain prejudicial circumstances, a pleasing green patina characterizes the metal surface in each type of atmosphere. Frequently (in urban districts invariably), the metal passes through a preliminary black stage, the persistence of which is favored by the presence of lead in the metal and by shielding from wind and rain. In general, the green patina consists essentially of basic copper sulphate. An exception to this is the product from a purely marine atmosphere in which basic copper chloride predominates; where urban and marine conditions coincide, however, then basic sulphate in the product greatly predominates over basic chloride. Contrary to the general belief, basic copper carbonate enters only to a minor extent into the composition of the product, even in rural districts remote from sea and town. Sulphur compounds, derived from

products of combustion and disseminated by wind, are the most potent agents in the development of patina. The underlying metal, after long periods of exposure, shows remarkable freedom from pitting. With the exception of lead, which tends to accumulate in the product, the impurities usually present in the metal have no appreciable effect on the composition or appearance of the patina.

Studies on the Crystallization of Gold from the Liquid State by C. O. Bannister.

This paper deals with the crystallization of gold from the liquid state and gives different methods of preventing undercooling and "flashing." It illustrates the formation of straight boundary lines by the interference of radial growth from two, three, and four nuclei, and the formation of curved boundary lines by retardation of growth from one center.

The Creep of 80:20 Nickel-Chromium Alloy at High Temperatures by A. Glynne Lobley and Dr. C. L. Betts.

Wires 0.018 in., 0.0625 in., and 0.25 in. thick were subjected to tensile stresses of 50, 100, 200 and 400 lb./in.^{2} at temperatures of 700°, 800°, 900° and 1,000° C. for a period of approximately 4,000 hrs., and accurate measurements made daily of the movements.

At the highest temperature there was no evidence of creep stress limit.

The rate of flow was found to be dependent on the diameter of the wire as well as on the other factors.

The progress of the experiments is given in the form of abridged graphs, and graphs are also used to show the relationship between the various conditions of temperature, stress, and diameter.

The Reduction of Shrinkage Cavities and Vacuum Melting, by Dr. W. J. P. Rohn.

Shrinkage cavities may be diminished if care is taken that the solidification of an ingot starts from its bottom end and advances gradually to the top end. This control of the freezing process is not obtainable by using sand-molds or cast-iron molds but can be approximated to a certain extent with water-cooled copper molds. The special construction of such molds to be used in connection with vacuum melting furnaces, is described, and some details given regarding vacuum melting.

Shrinkage cavities it is shown may be totally avoided if melting and freezing are performed in an electrically heated melting furnace in a crucible of the shape of a finished ingot, and, after melting and refining is completed, the current is cut off gradually from the bottom with a well-controlled speed. Illustrations of cross-sections of ingots so produced, and of their crystal structure, are given.

Progress in Electric Furnaces for Non-Ferrous Metals, by M. Tama.

New induction furnaces of large capacity are described. They have been developed for high melting-point alloys such as nickel-brass and phosphor-bronze. Thirty-four electric annealing furnaces of the resistor type are shown to be in successful operation in a large metallurgical plant. The advantages of the use of electricity both for melting and annealing non-ferrous metals are emphasized. Recent improvements in refractory linings for melting copper alloys, devices for charging swarf into electric furnaces, and various types of electric bright annealing furnaces are described.

Pinholes in Cast Aluminum Alloys, by Dr. N. F. Budgen.

The paper describes an investigation into the causes of pinholes in sand-cast aluminum alloys, and describes the various forms of pinholes that are seen. The notes are confined largely to the observation of sand-cast test-blocks 3 in. in diameter by 3 in. deep.

Gas evolution at solidification is considered to be the causation factor of greatest importance and the means whereby gases may be absorbed by aluminum alloys are discussed. Shrinkage during solidification is considered to play some part in producing pinholes.

The influence of the aluminum ingot itself, the melting and pouring temperature, the time maintained molten, the melting fuel and furnace, the rate of solidification, the turbulence of pouring, and the alloying elements are separately considered in relation to their effect on pinholing.

Means for preventing pinholes are described.

Properties of Locomotive Firebox Stays and Plates, by Dr. O. F. Hudson, D.Sc., T. M. Herbert, Dr. F. E. Ball and E. H. Bucknall.

This paper is published by permission of the Council of the British Non-Ferrous Metals Research Association, and deals with some of the results of metallurgical interest arising out of the Research on "Copper Locomotive Stay Rods" which the Association is carrying out on behalf of the British railways.

Of the two main sections of the paper the first is devoted to a consideration of the conditions existing in a locomotive firebox and gives very briefly the principal results of the investigation into the causes of the wastage of stayheads in service. The main results obtained in the determination of the composition of firebox gases and temperatures of stayheads (described more fully elsewhere) are indicated, and the authors show that, while wastage is primarily dependent on oxidation of copper, the severer forms are caused by the action of water leaking between stays and plate, this leakage water bringing about the loosening of the hard adherent oxide scale normally formed on arsenical copper in a firebox and leading to its detachment and the exposure of fresh copper surfaces to oxidation. The authors have arrived at the conclusion that leakage results from the plastic deformation of copper under the influence of thermal stresses, which leads to loosening of the fit of the stays screwed into the copper plate.

The other main section, Part II, of the paper gives the results of an investigation of the oxidation of arsenical copper in firebox atmospheres, the properties of the oxide scale formed, and the action of leakage liquid. The rate of oxidation of arsenical copper in various atmospheres has been determined within the range of 260°-600° C. The presence of small proportions of chlorine as hydrochloric acid gas causes a very great increase in the amount of oxidation in air and other atmospheres, and the presence of sulphur dioxide also causes a marked increase, both these substances being present in firebox atmospheres. There was no evidence that the presence of arsenic in the copper had any influence on the rate of oxidation. The conditions necessary to the formation of the dense, hard, and firmly adherent oxide, which is characteristic of the scale formed on copper in a locomotive firebox, have also been studied, as well as those necessary to bring about loosening of the scale under the action of leakage water.

This section also contains the preliminary results of a study of the softening and elastic properties of cold-worked copper containing small percentages of other elements. This emphasizes the importance of a more thorough consideration of the mechanical and thermal properties of locomotive firebox materials, and already indicates the possibility of selecting improved materials, which should greatly reduce wastage of stayheads.

The investigation on the softening and elastic properties of copper is still in progress, but the results are given of a wide survey of the influence of other elements on the temperature of softening of copper in different de-

grees of cold-work. Tensile tests which have been made on a large number of these materials have included determinations of the elastic limit (limit of proportionality) at room temperature and also in some cases at a temperature of 300° C. The object of these tests is to obtain, by alloying and suitable mechanical and thermal treatment, copper, otherwise suitable for firebox purposes, which will have and retain at service temperature a reasonably high elastic limit, say, of the order of 5 tons/in.^{2}. The results have already shown that there is a reasonable prospect of achieving this object, one of the most promising alloy additions being silver, of which as small a quantity as 0.05 per cent appears to be sufficient.

Effect of Temperatures Attained in Overhead Electric Transmission Cables, by Dr. A. v. Zeerleder and Dr. P. Bourgeois.

The increases of temperature produced by a current of electricity in transmission cables made respectively of copper, pure aluminum, steel-aluminum, and Aldrey were measured. Cables consisting of these materials were submitted to temperatures lower than the usual annealing temperatures for periods ranging over several months up to one year, and the effect on the mechanical properties was examined. It was found that Aldrey is not affected by temperatures which will seriously diminish the tensile strength of copper. Cables consisting of aluminum alloys having undergone previously an appropriate heat-treatment—such as Aldrey—are thus able, in spite of their lower electrical conductivity, to carry higher current densities than copper, without danger of slow annealing.

The Relative Corrodibilities of Ferrous and Non-Ferrous Metals and Alloys, Part II—The Results of Seven Years' Exposure to Air at Birmingham, by Dr. J. Newton Friend.

Fifty-four bars of ferrous and non-ferrous metals were exposed to air on the roof of the Birmingham Central Technical College for seven years, and an account is given of the 17 non-ferrous bars. The metals examined included tin, lead, nickel, zinc, aluminum, and various coppers and brasses. All resisted corrosion much more efficiently than the wrought iron and carbon steels. Nickel proved less resistant than copper. Aluminum ranked with lead, tin, and stainless steel in offering a very high resistance to corrosion. The influence of arsenic on copper is discussed.

Idiomorphic Crystals of Cuprous Oxide in Copper, by C. Blazey.

A description is given of idiomorphic crystals of cuprous oxide in copper containing 0.43 per cent oxygen, which had been heated for a long time at a temperature above 800° C. The grain size of the copper was large and the cuprous oxide crystals were arranged in groups with uniform orientation, but in any one grain of copper the orientation of the groups varied. It does not appear to be necessary to have either slow cooling through the solidification range or a high oxygen content for the development of idiomorphic crystals of cuprous oxide. Long heating at a high temperature is necessary with, possibly a favorable relationship to the crystallographic planes of the copper matrix.

Precious Metal Sweeps

Q.—We are taking the liberty of asking you to help us with regard to some little difficulties that have cropped up in our precious metal sweep collecting. After grinding our sweeps we have been in the habit of passing them through a forty mesh sieve and then putting them into a rotating barrel letting them run for several days.

We have been advised that if we put the sweeps through a sixty mesh sieve we should be doing something which would be to our benefit and that we would be more likely to get far greater returns from our sweeps than we have heretofore.

We would take it as a very great favor if you would advise us on this point and give us any other information connected with these sweeps which you think would prove useful.

A.—The finer you grind your sweeps, the easier it is to recover value from the dust. However, it takes money and effort to do the grinding and there is a certain point at which the increased return is offset by the expense of the grinding. It is hard to say just where that point is; it depends upon the quantity of material handled, the cost of power, etc.

If you are in doubt as to whether you are getting full returns or not, we suggest that you have an assay made by a competent referee. This would probably be cheaper than to experiment, and more conclusive.

—Jewelry Metallurgist.

Granulating Tin

Q.—We wonder if you can tell us how to granulate tin? We want it to be about 20 to 40 mesh. Any information that you can give us will be appreciated.

A.—To granulate tin, melt the tin and pour in a tank of hot water, using a tank about six feet deep and a trough of iron. Pour the metal down the trough into the heated water. The speed and drop will regulate the size. A little practice will soon give you the correct pouring speed and drop for your requirements.

—W. J. Reardon.

Hard Aluminum Alloys

Q.—We have at hand an inquiry for an aluminum alloy casting to test 115 Brinell. We would appreciate very much if you could furnish us with the necessary information for obtaining such an alloy.

A.—We know of no aluminum alloy which will test 115 Brinell as cast. In order to obtain such hardness and strength it is necessary to heat treat the castings, which must be made from an alloy capable of being hardened by heat treatment. Among alloys of this character are No. 122, containing 10 per cent copper, 1.2 per cent iron and 0.25 per cent magnesium; No. 142, containing 4.0 per cent copper, 2.0 per cent nickel and 1.5 per cent magnesium; and No. 196, which contains 5.0 per cent copper as the only alloying constituent in the aluminum.

Sand castings made from any of these alloys may be hardened, by special heat treatments which vary according to the alloy used, to a hardness of from 100 to 125 Brinell.

These heat treatments and their use in the production of hardened castings from any of the above alloys are patented and controlled by the Aluminum Company of America. Permission to use the process and information as to its details had best be obtained from them.

—H. M. St. John.

Smelting Secondary Aluminum and Aluminum Alloys

A Series of Articles on the Reclamation of All Forms of Scrap and Used Aluminum and Aluminum Alloys. Part 9—Furnaces Used in Melting*

By Dr. ROBERT J. ANDERSON
Vice President, Fairmont Manufacturing Company, Fairmont, W. Va.

WRITTEN ESPECIALLY FOR THE METAL INDUSTRY

MANY different types of furnaces have been used in practice for re-melting aluminum and aluminum-alloy scraps and wastes. Wide differences of opinion have been held regarding the most suitable kinds of furnaces to be employed in this class of work. Almost every type of furnace which has been used in melting aluminum alloys in foundry practice has also been used in secondary re-melting. Of late years, there has been a definite tendency toward standardization in the secondary field with the development of the stationary hearth-type open-flame furnace (so-called reverberatory). Naturally, the choice of furnace to be employed by the aluminum smelter is governed by three main factors, viz., (1) the class of scrap to be run, (2) the volume of production to be turned out, and (3) the fuel available. Modern practice by secondary smelters who run a production of 5,000,000 to 20,000,000 pounds of scrap per annum demands the use of large units, and the stationary hearth-type furnace is favored. Where certain scraps and wastes are melted in small lots by founders, small furnaces of the iron-pot type are favored and may be quite suitable under specific conditions.

The various types of furnaces actually used so far in practice include the following: Pit furnaces, stationary and tilting crucible furnaces, stationary and tilting iron-pot furnaces, open-flame tilting furnaces of several designs, and stationary and tilting hearth furnaces. Electric furnaces of several types have been tried experimentally (and actually used to a slight extent) for the re-melting of aluminum and light scraps, but their use has not become practice so far as the writer is aware. Pit furnaces are usually fired by coal or coke, while oil or gas (natural or artificial) are ordinarily employed as the fuel with the other types above mentioned. Both coal and coke have, however, been used for firing the hearth-type furnaces.

On account of the tendency for aluminum to oxidize rapidly at high temperatures, particularly when in the form of small pieces like borings, the constitution of the furnace atmosphere is usually regarded as important in relation to recovery. Atmospheres rich in oxygen are to be avoided. Open-flame furnaces, generally speaking, can be operated with atmospheres lean in oxygen and rich in carbon dioxide under proper conditions of firing. As already pointed out, the nature of the scrap to be melted has some bearing on the type of furnace to be used. Thus, for various reasons, certain types of furnaces are practically ruled out for running borings or dross metallics. At the same time, the large hearth-type furnace possesses so many advantages over the other types mentioned that it is generally to be recommended for all re-melting when the tonnage to be handled is large. Moreover, since, under present conditions the re-melting of aluminum and alloy scraps and wastes must be carried out in large volume production in order to be profitable, this rules out the small pit, crucible, and iron-pot furnaces. The maximum capacity of these latter does not normally exceed 500 pounds of metal. Too, the atmosphere overlying the metal in these furnaces is chiefly air, which is undesirable.

When borings or dross metallics are to be run, a furnace must be employed which is adapted to puddling, usually hand puddling. Large furnaces are, of course, advantageous, irrespective of the type, as contrasted with small units, since the former provide faster melting, use less fuel per unit weight of metal melted, permit the charging of larger pieces of scrap, and have lower operating costs for labor.

Pit Furnaces

The pit furnaces which have been used for melting aluminum scraps are similar to those employed in brass foundries. Such furnaces may be fired with coal or coke and have natural or forced draft. Most pit furnaces are fired by coke, although both bituminous and anthracite coal are used, and natural draft is most frequently employed. Pit furnaces are built to take from No. 40 to No. 400 crucibles, and a common size holds a No. 80 crucible. This latter has a capacity of about 80 pounds of aluminum. Pit furnaces have been used chiefly in foundry departments for recovering wastes arising in plant-manufacturing operations on aluminum-alloy castings, or for sweating metal from drosses. The pit furnace is not favored by large smelters. Pit furnaces are out of the question for volume production, they are expensive to operate as regards fuel, the crucible cost is high, and temperatures are controlled with difficulty.

In running borings in pit furnaces, it is difficult to poke this scrap down into the crucible and then puddle it because of the heat, the unwieldy puddling tool required, and the bad vapors that arise—either from oil in the borings or from the fluxes used. One smelter formerly ran borings in a coke-fired pit furnace, using a No. 120 crucible. In another plant, various scraps were run in a coke-fired natural draft pit furnace, holding a 300-pound capacity crucible. Pit coke furnaces have been abandoned by a number of firms as being quite unsuitable for re-melting aluminum and alloy scraps. Fuel costs in operating these furnaces have run as high as 0.8 ct. per lb. of material charged, which is quite out of line with the costs obtainable with open-flame furnaces.

Crucible Furnaces

Crucible furnaces have been used to some extent in secondary aluminum work but are employed only in a

*Parts 1, 2, 3, 4, 5, 6, 7, and 8 were published in our issues of January, 1925; September, 1925; February, 1926; May, 1926; November, 1926; July, 1927; November, 1927, and August, 1928, respectively.

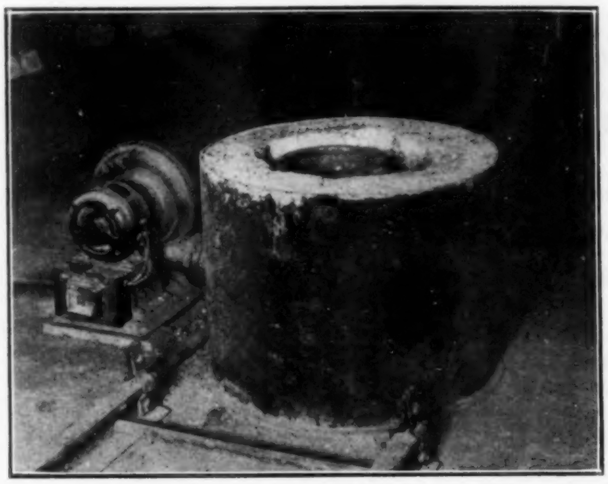


Fig. 1—Gas-Fired Stationary Crucible Furnace

minor way in the United States at the present time. They are more favored in Europe. They have the same general disadvantages as pit furnaces, although temperatures can be controlled better in the crucible furnace than in the pit coke furnace. While both stationary and tilting crucible furnaces have been employed in light alloy foundry practice, the tilting type has been used but little for secondary melting.

The stationary crucible furnace is of simple design and construction, consisting of a graphite-clay (plumbago) crucible set in a cylindrical space made by lining a steel shell with refractory material. The shell may be set down partly in a pit, or it may be above the level of the floor (generally the latter) and built as a separate unit. The tilting furnace consists of a steel shell lined with refractory material, in which a graphite-clay crucible with a molded pouring lip is placed. The shell is mounted on trunnions and fitted with the necessary tilting mechanism. Both the stationary and tilting types are built in various sizes to hold up to No. 600 crucibles, but those holding No. 60 to No. 100 crucibles are usual sizes. Fig. 1 shows a small gas-fired stationary crucible furnace, with a No. 150 crucible in place.

In the crucible furnace (either stationary or tilting), the crucible is heated over its exterior surface by the combustion of fuel (gas or oil) from one or more burners. The waste gases are discharged through a hole in the furnace cover, or when run without a cover directly upwards into the air, or through a port at the top of the shell wall. The flames are projected tangentially so that they are given an upward and rotary motion around the crucible. The chief disadvantages of crucible furnaces are small capacity, poor fuel efficiency, and high cost of crucibles due to breakage and wear. In one installation (an oil-fired stationary crucible furnace), the fuel cost amounted to about 0.6 ct. per pound when operated on borings. This is, of course, very high.

Iron-Pot Furnaces

Iron-pot furnaces are still used to some extent in secondary work, particularly in the dry process of running borings. However, these furnaces are not favored by the majority of smelters, and the dry process is used but little. Cast-iron pots have comparatively short life in running certain classes of scraps (due to local over-heating which occurs), and appreciable quantities of iron are likely to be absorbed from the pots if the temperature gets too high or if certain compositions of scrap are re-melted in them. While both stationary and tilting iron-pot furnaces have been used in re-melting scraps, the former are generally preferred. The stationary pot holding 300 pounds of metal is an usual size, while tilting pots are made in capacities of up to about 600 pounds, the larger sizes being usual.

Stationary iron-pot furnaces may be run as separate units or in a battery of several pots to a bank. Pots are usually shaped like a bee-hive. Oil or gas is generally employed as the fuel. The pot is heated over its exterior surface by the combustion of fuel in the space between the furnace walls and the pot. The products of combustion are vented through a port in the wall at the top or through holes around the flange of the pot.

With single-unit stationary furnaces, the furnace consists of a steel shell lined with refractory brick, and the pot is suspended by its flange resting on the walls. The pot may be supported from below by a refractory stool. One burner is ordinarily employed to fire single units, and this is so placed that the flames do not impinge directly on the pot but rather circulate freely around it. In the case of the tilting type, the furnace consists of a steel shell lined with refractory brick and mounted on trunnions; the pot, with special pouring lip, is suspended by its flange from the wall top and also held in place by clamps so that it will not fall out when the furnace is tilted. Fig. 2 shows a cross-section of a stationary iron-pot furnace, indicating the size of pot and the construction. Fig. 3 shows a typical tilting iron-pot furnace. Generally speaking, the fuel efficiency of iron-pot furnaces is not good, although on the average they excel crucible furnaces in this respect.

Both crucible and iron-pot furnaces of the stationary types may be equipped with hoods in the form of sheet-iron cylinders set on top of the furnaces. A wide door is provided in the cylinder for charging, puddling, and ladling.

Open-Flame Furnaces Other Than Reverberatories

Open-flame furnaces, other than reverberatories (stationary hearth-type furnaces), have not been used much in secondary work. There are several types of open-flame furnaces which have been employed for melting aluminum alloys, chiefly in foundry practice. The principal types include the following: egg-shaped tilting furnaces; pear-shaped (upright) tilting furnaces; cylindrical tilting furnaces; cylindrical stationary (tapping) furnaces; and cylindrical rotating and tilting furnaces. Open-flame furnaces of the types just mentioned are fired by oil or gas, and combustion of the fuel takes place in the melting chamber itself. Thus, the metal is in intimate contact with the products of combustion. Speaking generally, these furnaces consist of a steel shell of the desired size and shape lined with refractory material, and mounted on trunnions or other suitable mechanism if of the tilting type. Capacities range from about 100 to 6,000 pounds of aluminum, an usual size being 1,000 pounds in the case of the cylindrical tilting furnace.

Open-flame furnaces are well adapted to melting certain

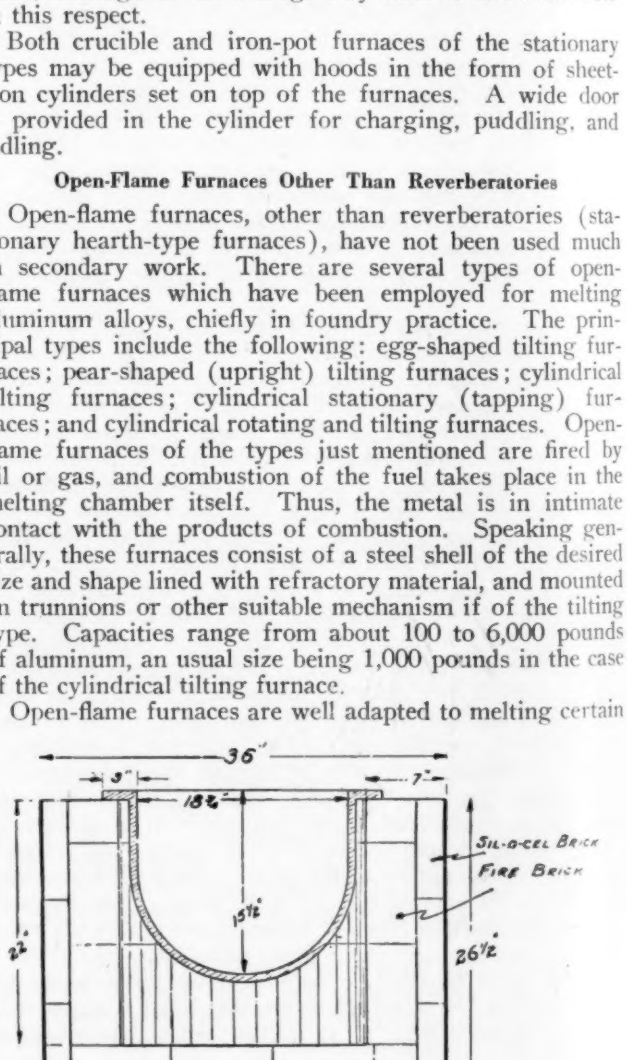


Fig. 2—Cross-Section of Stationary Iron-Pot Furnace

types of scrap (which do not require puddling) for small to medium production, but they are not useful for running borings or dross metallics. The chief advantage of the open-flame furnace is rapidity of melting and good fuel efficiency, but oxidation losses are likely to be unduly high. These furnaces need not be given any detailed consideration here since they are used to a relatively small extent in secondary aluminum practice.

Open-Flame Hearth-Type Furnaces

As pointed out previously, the stationary open-flame hearth-type furnace (so-called reverberatory) is being favored by most secondary smelters for the re-melting of various scraps. The first furnaces of this type built for aluminum and alloy scrap melting were of rather small size, as compared with furnaces being constructed today, e. g., having capacity of say up to 6,000 pounds. Later furnaces to hold 12,000 pounds and then 20,000 pounds were built, and at the present time one plant is putting in a furnace to hold 50,000 pounds of aluminum. From the point of view of labor and fuel costs and recoveries, the open-flame hearth-type furnace, if correctly designed and operated, gives the best results of any furnace with which the writer has had experience. While large and continuous production is necessary for the best results in the operation of this type of furnace, still the smaller sizes may be used to advantage under certain conditions. In general, the larger the charge, the faster is the speed of operation, the less the fuel consumption per pound of metal recovered, and the more uniform is the resultant metal or alloy. A furnace to hold 40,000 pounds or more of metal is especially well adapted to carload business and enables the smelter to blend and melt sufficient metal at one charge to make an entire carload of uniform composition. This type of furnace has been described recently by the writer, G. E. Hughes and M. B. Anderson[1].

The actual recovery of metal from metallics, borings, and other light scraps is higher in the hearth-type furnace than in the small pit, crucible, or iron-pot types. With good fitting doors, the atmosphere of the hearth-type furnace can be controlled so as to be low in oxygen and high in carbon dioxide. Control of the atmosphere is not so important when running down dross metallics or borings under a heavy blanket of liquid (molten) flux as it is in re-melting heavy scrap without a flux cover, but in any case an atmosphere low in oxygen is to be pre-

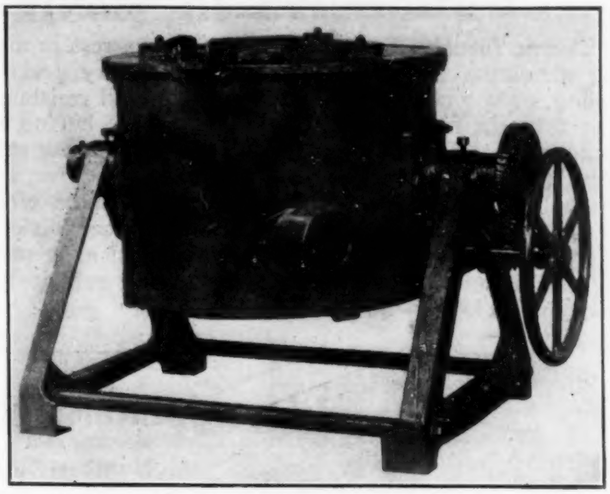


Fig. 3—Tilting Iron-Pot Furnace (Coleman Type)

ferred. The large hearth-type furnace is advantageous for handling large scrap, e. g., whole crank-cases, since such scrap need not be broken up as is usually necessary with small furnaces of the kinds previously mentioned. By providing wide doors, crank-cases and other large pieces of scrap can be charged whole. This type of furnace is well adapted to puddling and may be worked by several men at the same time.

Fig. 4 shows a stationary open-flame hearth-type furnace of 12,000 pounds capacity, as designed and built. The hearth, side walls, and roof are built of good grade fire brick, while the outside face walls may be made of common brick. The furnace should be insulated by laying up a layer of 4-inch insulating brick between the 9-inch wall bricks and by backing up the hearth and covering the roof with the same material. Light old rails may be used as the buckstays. The face walls may be cased with light boiler plate. In the furnace shown, the firing is by natural gas from two burners placed on either side of a stack at the rear. This method of firing has shown definite fuel economies over firing through the side walls or the front walls. The furnace has four large charging doors, two on either side. These doors permit rapid and easy charging. Liquid metal is removed from the furnace by tapping through a tap hole and allowing it to flow down a runner into a ladle.

The preparation of a tight bottom in a furnace of this type is important. In the case of ordinary fire brick and other refractory hearths, there is usually some leakage of metal through the bottom. This may be minimized by proper interlocking of the bricks in laying up the hearth. In one plant, this type of furnace is built by laying the hearth brick in a lining of wrought iron in the form of an open box.

The fuel efficiency of the open-flame hearth-type furnace is much higher than that of the crucible or iron-pot types and may be as good as that of the several open-flame tilting furnaces previously mentioned. Efficiencies of at least 20 per cent are obtained when running heavy melting scrap. This type of furnace is usually fired by oil or gas, although it may also be fired by coal or coke. Certain modifications in the design are necessary for firing with solid fuel, and fire box and grates must be provided.

Tilting open-flame hearth-type furnaces of relatively small capacity, say up to 2,000 pounds, have been used in secondary aluminum practice. These have been fired by oil, gas, and solid fuel. So far, large size tilting furnaces of this type have not been used for aluminum, although they offer a number of advantages. The chief disadvantage is high first cost.

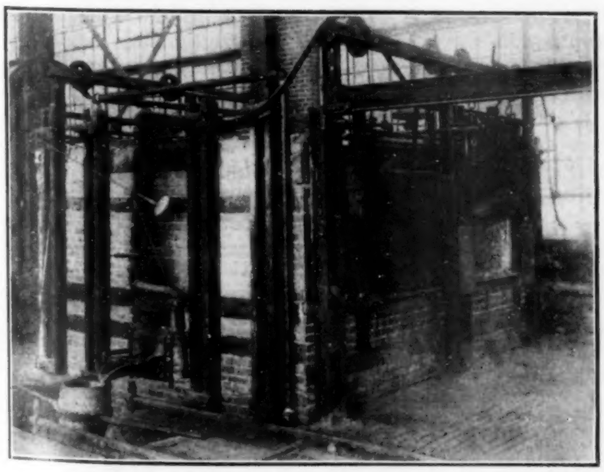


Fig. 4—Open-Flame Stationary Hearth-Type Furnace, 12,000 Pounds Capacity

[1] R. J. Anderson, G. E. Hughes, and M. B. Anderson, An open-flame stationary hearth-type furnace for melting aluminum and its alloys, preprint No. 29-6, April, 1929, meeting of the Amer. Foundrymen's Assoc. at Chicago.

Electric Furnaces

Electric furnaces have made but little progress in melting aluminum or its alloys either in foundry practice, rolling, or secondary smelting. Both arc- and resistance-type furnaces have been tried experimentally, but no advantage is seen in their use. With the usual power rates prevailing in industrial centers, electric-melting furnaces are out of the question for secondary aluminum work. At the present time, electric furnaces are receiving considerable attention abroad for aluminum and alloy melting, but there is practically no interest being exhibited in them in the United States.

The various types of furnaces which have been used for melting aluminum and its alloys have been discussed in detail elsewhere[2, 3] and in the present article their application to secondary work has been indicated.

The tenth article in this series will deal with miscellaneous equipment and tools used in secondary aluminum work.

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[2] R. J. Anderson, Aluminum and aluminum alloy melting furnaces, Trans. Amer. Foundrymen's Assoc., vol. 30, 1923, pp. 562-604.

[3] R. J. Anderson, The metallurgy of aluminum and aluminum alloys, Henry Carey Baird and Company, New York, 1925, see Chapter IX.

This series will be continued in an early issue.—Ed.

Electroplaters Welcome Dr. Sanigar

By HORACE H. SMITH

President, American Electroplaters' Society

ON behalf of the American Electroplaters' Society it gives me great pleasure to extend to Dr. E. B. Sanigar of Birmingham, England, our best wishes for the research work he is to undertake on electroplating as the first Weston Fellow of the American Electro-Chemical Society, at Columbia University under Dr. Fink.

We cordially invite Dr. Sanigar to attend any of our Society meetings, and all privileges will be freely extended to him.

Editorial comment and approval of the selection of Dr. Sanigar for this post will be found on page 484 of this issue. A brief biography is published on page 494.—Ed.

Brass Plating Practice

Q.—We are using a standard brass plating solution consisting of 4½ oz. sodium cyanide, 3 oz. copper cyanide, 1 oz. zinc cyanide, 1 oz. bicarbonate soda, ½ oz. ammonium chloride. We are contemplating the purchase of new anodes. We desire an anode that will give us the best results and from which we can deposit the maximum amount of brass. Shall we use 80 per cent copper and 20 per cent zinc, or 80 per cent copper, 10 per cent zinc and 10 per cent tin?

We have been told that the tin helps to prevent anode corrosion and keeps the anodes in a much brighter condition and also produces a softer anode. We are plating a steel sheet which we lacquer. The edge of the sheet, in its use, comes in contact with moisture which undermines the lacquer and produces a dark, blackish-brown discoloration. Do you know of any way of overcoming this? Also advise us of the most practicable metal with which to plate the steel before brass plating.

We are having difficulty with our anodes corroding. They first turn a light brown, and then black. We have tried adding sodium cyanide, ammonium chloride and bicarbonate of soda. We have also added some caustic soda. We have also found that sodium cyanide seems to darken them more than ever. We have been advised that we should not add caustic soda as it will react against the ammonium chloride. What shall we do?

A.—It is unnecessary to use anything in a brass solution except cyanide of copper, cyanide of zinc, sodium cyanide and soda ash. The anodes should be 80 per cent copper and 20 per cent zinc. Tin will not go into solution and therefore it should be kept out of the anodes. If it is used it will form as sludge on the anodes and prevent the free passage of the current. Being insoluble, it will fall to the bottom of the tank. Bicarbonate of soda will neutralize some of the free cyanide and change into carbonate of soda (soda ash). It is better to add the soda ash directly. Caustic soda should not be added unless anodes high in zinc are used. Such anodes will not give a good brass color in the deposit.

Steel can be plated directly with brass. No under deposit is necessary.

The discoloration of the deposit may be due to the quality of the lacquer used. Obtain a copy of a paper on "Spotting Out" by W. P. Barrows from the Superintendent of Documents, Government Printing Office, Washington, D. C. (15c.) and read about the effect of lacquer on plated surfaces. Ammonium chloride should not be used in a brass solution. The chloride may cause anode polarization.

—ELECTROCHEMICAL ENGINEER.

Rapid Tin Plate Solution

Q.—We would greatly appreciate any information you can give us with reference to tin plating on plain steel.

At present it is taking us a little more than fifteen minutes in the plating tanks to get a satisfactory plate and as this is quite a handicap in production, we are anxious to find some method or tin plating solution that will materially reduce this time. We are not so much interested in this finish from a rust resisting standpoint as the appearance and if we could get a good strike in half the time that it now takes us we would be able to step up our production 100 per cent, which it will be absolutely necessary for us to do with our present equipment.

A.—The formula you use is not given. A good deposit of tin can be had from the following solution in from 5 to 10 minutes:

Water	1 gallon
Sodium stannate	24 oz.
Tin chloride	¼ oz.
Powdered rosin	1/32 oz.

The solution is run at 140° F., with 15 amperes to 1 sq. ft. of work surface, at 3 volt pressure.

The deposit will be frosty. We know of no method to deposit a bright coating of tin.

—ELECTROCHEMICAL ENGINEER.

Electrochemical Society Meets in Pittsburgh

Important Sessions on Electrodeposition, Electric Furnaces and the Contributions of Electrochemistry to Aeronautics

By H. M. ST. JOHN
Metallurgical Editor

THE American Electrochemical Society held its fall convention in Pittsburgh, Pa., September 19-21. Several hundred chemists, metallurgists, plant executives and company officials of both the United States and Canada were present.

A special feature of the meeting was a symposium on the contributions of electrochemistry to aeronautics with special emphasis on the light alloys used in airplane construction.

A number of the industries of Pittsburgh co-operated with the Society, extending to its members the courtesy of a personally conducted tour through their plants. In addition to these plant visits which included the U. S. Aluminum Company, the Westinghouse Electric and Manufacturing Company, the U. S. Light Storage Battery Company and many others, the members were treated to sight-seeing tours, golf and there was a special program for the ladies.

Another technical session of importance was the one on electrodeposition.

The officers of the Society are as follows:

President, Francis C. Frary, Aluminum Company of New Kensington, Pa.

Past president, Paul J. Kruesi, Chattanooga, Tenn.

Vice-presidents: F. N. Speller, Alfred Stansfield, Sidney D. Kirkpatrick, G. B. Hogaboom, B. D. Saklatwalla, and O. W. Storey.

Managers: R. L. Baldwin, H. C. Cooper, O. C. Ralston, F. M. Becket, L. E. Saunders, S. Skowronski, S. C. Lind, W. Lash Miller, S. S. Sadtler.

Treasurer, Acheson Smith, Niagara Falls, N. Y.

Secretary, Colin G. Fink, Columbia University, N. Y.

Abstracts of papers read at the various meetings relating to non-ferrous metals are as follows:

Contributions of Electrochemistry to Aeronautics

ON September 19th was held a symposium on "Contributions of Electrochemistry to Aeronautics" with Dr. J. D. Edwards presiding. Among those who participated in this discussion were Edward P. Warner, Editor of "Aviation" and formerly Assistant Secretary of the Navy for Aeronautics, Dr. George W. Lewis, Director of Aeronautical Research, National Advisory Committee for Aeronautics, Starr Truscott, Assistant to Dr. Lewis, and Dr. Francis C. Frary, President of the Electrochemical Society and Director of Research for the Aluminum Company of America.

The general discussion of structural materials for aeronautical use centered around three points, (1) weight, (2) strength and endurance, and (3) resistance to corrosion. Mr. Warner pointed out that, in the case of airplanes, wood is still the dominant structural material because of its lightness and known properties, but that metals are gaining, because of their rigidity, as new alloys are developed and their properties become better known. Dr. Lewis stressed the importance of weight and its bearing on the "pay load," with particular reference to commercial airplanes and dirigibles. While safety is always the prime requisite it is evident that every pound which can be saved in the weight of the ship itself, without sacrificing safety, is of very great value. Various speakers estimated the numerical value of this weight saving as from $25 to $40 per pound. It was agreed that there still remains a very strong incentive for the further development of strong light alloys.

There were several papers dealing with light alloys now in use or of promise for future use in aeronautic construction. Their abstracts are given below.

ALUMINUM AND ITS ALLOYS IN AIRCRAFT

By T. W. BOSSERT

The evolutionary stages of aircraft construction are outlined. The widespread adoption of metal construction in aircraft has resulted from the availability of the strong aluminum alloys, with the strength of structural steel but only one-third its weight. The properties of these alloys are outlined and characteristic examples of their application are described and illustrated.

MAGNESIUM AND ITS ALLOYS IN AIRCRAFT

By W. G. HARVEY

Magnesium metal is one-third lighter than aluminum, and is used in airplane construction. Due to its inherent chemical and mechanical characteristics, it has been difficult to work the metal into useful shapes. However, recently, through the discovery of methods of purification of the metal and of the methods of heat-treatment of magnesium alloys, most fabricating obstacles have been overcome. Today magnesium alloy castings are made possessing mechanical properties substantially equal to the best of the high-strength aluminum alloys. The mechanical properties of magnesium alloys are tabulated. Through careful purification of the magnesium metal and alloying this with certain metals, such as manganese, alloys have been developed which show remarkable resistance to corrosion. The making of magnesium forgings has just emerged from the experimental stage. The forgings possess comparatively high mechanical strength. Forged magnesium propeller blades can be produced with weights not differing materially from those obtained with wood.

THE POSSIBLE USE OF BERYLLIUM IN AIRCRAFT CONSTRUCTION

By H. W. GILLETT

The physical properties of beryllium are briefly reviewed. An outstanding property is the high modulus of elasticity. Beryllium is more abundant in the earth's crust than either lead or zinc. Some day beryllium will be an important factor in aircraft construction.

Papers on Electrometallurgy

THE EFFECT OF IRON ON THE MAGNETIC SUSCEPTIBILITY OF ALUMINUM

By Ralph B. Mason

Values published to date on the magnetic susceptibility of aluminum have not been considered trustworthy, owing to the presence of iron and other impurities in the samples of aluminum tested. Accordingly, the magnetic properties of the purest aluminum obtainable today (99.97 per cent Al) are investigated and compared with commercial grades of Al and various alloys. It is found that pure aluminum is paramagnetic. Furthermore, the paramagnetic property of aluminum is only very slightly increased by the presence of iron up to 8 per cent, because the iron occurs as an intermetallic compound. Upon etching the surface of the sample with sodium hydroxide solution, the iron-aluminum compound is broken up, and the liberated iron in the surface film produces a marked increase in magnetic susceptibility. The magnetic method described is useful in the approximate estimation of the iron content of aluminum, but is not recommended for the accurate determination of small percentages of iron in aluminum.

THERMO-ELECTRIC TESTS FOR ALUMINUM-MANGANESE AND OTHER ALLOYS

By Cyril S. Taylor and Junius D. Edwards

One per cent of manganese added to aluminum has a marked effect upon the thermo-electric properties of the metal. The high thermo-electric potential of the couple: **Alloy (Al + 1 per cent Mn) vs. pure aluminum,** forms the basis of a new sensitive instrument for distinguishing between pure Al and the Al-Mn alloy. The instrument is also applicable for testing magnesium base alloys containing Al against pure Mg; the galvanometer deflection is roughly proportional to the percentage of Al present.

THE CORROSION RATE OF FERRO-NICKEL ALLOYS

By Colin G. Fink and Claude M. DeCroly

In the chemical engineering industry there has been an increasing demand for special alloys resistant to various chemical reagents. The authors record tests made on commercial alloys of the iron-nickel series, using the intermittent corrosion test, as this more nearly approaches actual service conditions. Specifications laid down by the American Society for Testing Materials were followed as closely as possible. Results in general indicate that the rate of corrosion in sulfuric acid increases at first very rapidly with the concentration of the acid, reaches a maximum, then decreases again, reaching a minimum, and usually increases again to reach a second maximum. The addition of small percentages of chromium to the alloy, for example, up to about 4 per cent, does not materially alter the general trend of the nickel-iron curves. However, higher percentages, such as we find in nichrome, with 12.5 per cent chromium, tend to eliminate the first sharp rise in the corrosion rate. Nor is there in these high chromium alloys a distinct minimum to be detected. On the other hand, other alloys quite distinct in composition from the ferro-nickel alloys, such as the commercial copper alloy Barberite, composed of copper with a little nickel, tin, and silicon, give the same type of corrosion rate curve as the ferro-nickel alloys. The addition of chromic acid to the sulfuric acid does not render the surface of the nickel-iron alloys passive, but, on the contrary, accelerates the corrosion. Contact potential measurements, made with the different samples of ferro-nickel alloys show a relation between voltage and acid concentration somewhat similar to the corrosion rate relation, but in other respects are more or less distinct, indicating that **the rate of corrosion is primarily dependent upon the rate of oxidation by the oxygen dissolved in the sulfuric acid, and not by the rate of ionization of the metal.**

ACCELERATED CORROSION TESTS FOR COATINGS OF THE IRON PHOSPHATE TYPE

By E. M. Baker, A. J. Herzig and R. M. Parke

Coatings of the iron phosphate type, often used in place of certain electroplated coatings, were produced on mild steel from solutions containing various concentrations of iron phosphate and phosphoric acid. The salt spray test, and intermittent immersion tests in distilled water and 0.01 normal sulfuric acid were found to be suitable for evaluating the quality of the coatings. Intermittent immersion tests in 5 per cent and 20 per cent salt solutions were unsuitable. Substantially all the iron in the solution is in the ferrous state after the bath has been in operation. Some observations are presented on the effect of bath composition on the quality of coating, and on the optimum bath composition for best quality.

SOLUTION POTENTIALS OF ALUMINUM ALLOYS IN RELATION TO CORROSION

By Julius D. Edwards and Cyril S. Taylor

The potential differences arising from contacts between aluminum and aluminum alloys, as well as other metals, in the presence of an electrolyte, are of theoretical interest and practical importance. Although these potential measurements show such wide variations that their quantitative significance is limited, qualitatively they are important in explaining the behavior of the metals in contact under corrosive conditions. Pure aluminum is electronegative to many of its alloys, and particularly to 17S or duralumin. This fact is of importance in connection which the protection of exposed edges on duplex metal products, such as "Alclad" sheet.

STUDIES OF OVERVOLTAGE ON METALS

By P. Sederholm and C. Benedicks

The authors have empirically established that the regular, half immersed, hydrogen electrode is completely reversible along a straight volt-ampere line, even within the region of oxygen discharge, at least with anodic currents below 1 milliampere. It has also been found that the same condition prevails when the hydrogen electrode is totally immersed; in this case, however, the reversible portion of the volt-ampere curve for the discharge is a very restricted one. A smooth, bright platinum gauze electrode is shown to give the same potential as an electrode of platinized platinum, provided some oxygen has been precipitated on it, the oxygen acting as a depolarizer. In the same manner as overvoltage occurs on the liberation of hydrogen, overvoltage also occurs on the discharge of oxygen, and is, in the case studied, about twice as large as that for hydrogen.

Electrodeposition

ONE of the Saturday morning sessions, under the auspices of the Electrodeposition Division, covered a wide field in the discussion of electroplating theory and practice.

THE DETERMINATION OF SULFATE IN CHROMIC ACID AND IN CHROMIUM PLATING BATHS

By H. H. WILLARD and RICHARD SCHNEIDEWIND

To make an accurate sulfate determination in chromic acid, the latter must be reduced to a chromic salt. In this solution the chromium is present as a complex ion, containing some sulfate which is not precipitated by barium except on standing for a long time, and sometimes not at all. By heating with acetic acid a more stable complex is formed, containing acetate, and the sulfate being now in the ionic form is rapidly precipitated. As a rapid control method for plating baths, a measurement of the turbidity produced by the $BaSO_4$ is satisfactory. Instead of measuring the depth of liquid required to extinguish the light, as in the Parr Sulfur Photometer, it has been found more accurate to maintain a fixed depth of liquid and vary the strength of the light, measuring the voltage across its terminals or the resistance in series with it.

A TURBIDIMETRIC METHOD FOR THE DETERMINATION OF THE SULFATE CONTENT OF CHROMIUM PLATING BATHS

By LAWRENCE E. STOUT and A. W. PETCHAFT

This paper presents a new and rapid method for the determination of sulfates in chromium plating baths. In the literature there has been no method described previously, which has proved completely satisfactory for this type of analysis. The Parr sulfur-photometer can be used if strontium chloride be substituted for barium chloride, and if the funnel of the instrument be made of glass throughout, so that no rubber comes in contact with the solutions of chromic acid. The accuracy of the method described is at least comparable to any heretofore used, and is much more rapid and convenient, requiring neither chemical balance nor complicated gravimetric procedure.

In discussion Dr. William Blum of the Bureau of Standards expressed the sentiment of the meeting when he stated that both of these proposed methods constituted a distinct advance in a most troublesome and important feature of chromium plating practice.

SOME CHROMIUM PLATING EXPERIMENTS

By CHESTER M. ALTER and FRANK C. MATHERS

The authors find that chromium deposits more easily upon copper or iron than upon platinum or graphite. It is thought that this may, in some measure, account for the early controversy concerning whether or not chromium could be deposited from chromic acid solutions. Those who used copper cathodes had a much better chance of success than those who used platinum cathodes. Cobalt salts in the chromic acid bath prevent the deposition of chromium. Periodic reversal of the current, whereby the cathode is made for only a small proportion of the time prevents the deposition of chromium. Stirring the bath or momentarily lifting the cathode out of the bath reduces or prevents the deposition of chromium. Silica gel in the bath in sufficient quantities to prevent convection currents does not improve the throwing power nor increase the yield in chromium deposition. Copper, nickel, iron and various other metals in the form of chromates were without effect upon the deposition of chromium. These metals were not deposited with the chromium unless they were added in large amounts, and in no cases were the deposits satisfactory where another metal was deposited with chromium. Current efficiencies were increased by the use of a porous diaphragm, but the color of the deposits was poor when a porous cup was used.

EFFECT OF CURRENT DENSITY UPON THE HARDNESS OF ELECTRODEPOSITED CHROMIUM

By ROBERT J. PIERSOL

Using various current densities from 1 to 7 amp./sq. in (16 to 109 amp./sq. dm.) it is found that chromium has a maximum hardness when plated at about 4 amp./sq. in. (62 amp./sq. dm.). The value of this is approximately 43 times as great as that obtained at a normal plating current density of 1 amp./sq. in. (16 amp./sq. dm.) as shown by abrasion tests.

THE MEASUREMENT OF PH IN NICKEL PLATING SOLUTIONS

Compiled by W. BLUM and N. BEKKEDAHL

In recent years it has been found that very slight differences in the acidity of nickel plating solutions may affect the character of the deposited nickel. It is therefore the common practice to measure and control the acidity, which is expressed on a scale known as the pH scale. In general this has been done by simple colorimetric methods, which depend upon the color of indicators. Recently other methods including the use of "the quinhydrome electrode" have come into use. This investigation has shown that while the results with colorimetric methods are sufficiently reproducible to maintain the desired uniformity of the baths, they are numerically somewhat higher than the true value. It is therefore suggested that in future work and publications, when colorimetric methods are used, the results should be corrected to agree with the accepted standard values.

INSOLUBLE SULFATES AND PASSIVITY

By LEON MCCULLOCH

Iron, nickel and chromium have anhydrous sulfates which go into solution with difficulty. These sulfates may compose the films which cause the passivity of these metals in sulfuric acid. Cobalt and chromium anodes dissolve readily because they have easily soluble anodic products. It is suggested that any slowly soluble anode product may be the cause of passivity.

ELECTRODE POTENTIALS OF COPPER ANODES AND COPPER CATHODES

By EDWARD F. KERN and ROBERT W. ROWEN

The electrode potentials of copper anodes and cathodes were determined, and the effect upon the electrode potentials by varying the temperature and the composition of the electrolyte, by the composition and physical character of the anodes, and by the

additions to the electrolyte of glue and sulfite-waste residue in the proportions usually added to copper refining electrolytes. The static potentials of copper anodes and cathodes were found to be practically identical in the same cells; whereas, the dynamic potentials and the polarization potentials varied, and were dependent upon circulation and temperature of the electrolyte, composition and physical condition of the electrodes, and upon the presence of glue and of sulfite-waste residue, in the amount usually added to copper refining electrolytes. A comparison of the results obtained by the use of the Haring polarization and resistivity cell, by means of a saturated calomel half-cell, and a mercurous sulfate half-cell, showed that the most satisfactory results were obtained by the saturated calomel half-cell in connection with a potentiometer.

CATHODE POTENTIALS AND ELECTRODE EFFICIENCIES OF COPPER IN COPPER CYANIDE-SODIUM CYANIDE SOLUTIONS

By George M. Smith and J. M. Breckenridge

This paper gives a record of the kinetic potentials of a copper cathode, using various current densities and different concentrations of copper cyanide in sodium cyanide. Electrode efficiencies are given in various concentrations of the electrolyte, and at different current densities.

THE USE OF TANTALUM AS CATHODE FOR THE ELECTRO-DEPOSITION OF COPPER.

By Lester W. Strock and Hiram S. Lukens

Tantalum has been found to be a satisfactory cathode material in place of platinum for electroanalytical determinations. It was noted that the Ta cathode surface became darker in color and increased in weight after each deposition and cleaning cycle. This increase in weight was found to be due to the formation of an oxide film, produced by the nitric acid. This oxide film must be mechanically removed with an abrasive to insure good adhesion and concordantly good results. A high starting current density (3 amp./sq. dm.) insures even distribution of the Cu on the Ta cathode. Details of procedure are given.

LIME PROCESS FOR COATING ALUMINUM

By Leon McCulloch

Aluminum may be given a pleasing dead-white finish, by boiling it in a mixture of lime and calcium sulfate. A few uses for this process are suggested.

Electrothermic Session

ONE of the Friday sessions, under the auspices of the Electrothermic Division, H. M. St. John presiding, was devoted to an informal discussion on "Recent Developments in the Annealing of Non-Ferrous Metals." Robert M. Keeney of the Connecticut Light and Power Company opened this discussion with a talk on the present status of the industry in the territory served by his company. In the New England territory wood and oil have been the commonly used fuels for annealing brass, but both electricity and gas are now finding an increasing use. Electric furnaces are favored for the finish anneal because of the close control of physical properties which their use makes possible. Annealing with gas has been developed to a point where a fairly bright anneal of brass may be obtained and for this reason gas furnaces are gaining rapidly. The metal has a better surface and less pickling is necessary.

Oil has been the principal fuel for annealing copper but electric furnaces are rapidly coming into general use. A bright anneal is readily obtained by the use of water seals without the necessity of controlling the furnace atmosphere. Nickel silver can be annealed in electric furnaces having a hydrogen atmosphere, which eliminates all pickling. The cost of the hydrogen is about two dollars per ton of work annealed.

There was no stenographic record of the ensuing discussion which occupied about one hour. It was pointed out that electrically heated furnaces offer opportunities for control of the furnace atmosphere probably more effective than with gas or any other fuel. In any case, where exactness of temperature control is a factor electric furnaces should ultimately gain the upper hand.

Electric furnaces equipped with fans to heat the work by convection rather than by radiation are being used very successfully for low temperature heat treatment (up to about 1200° F.) and have the advantage that uniform temperatures are maintained throughout all parts of a bulky charge. To accomplish the same result by radiation it is necessary to spread the work out in a thin layer in order to avoid variations in temperature between that part of the work most nearly exposed to radiation and other less exposed portions of the charge.

Dr. P. H. Brace of the Westinghouse Company described a new type of coreless induction furnace, designed to operate on 60-cycle current, which has been in experimental use for a number of years and is now considered ready for general commercial use. In a size having a holding capacity of 750 lbs. and powered at 170 kva., this furnace will produce 400 lbs. of nickel-chromium alloy per hour, at an energy consumption of 650 kw. hrs. per ton. The crucible has a life of 50 to 150 heats. The overall operating costs are about the same per ton of melt as those experienced with a 3 ton arc furnace. The furnace is equipped with capacitors which bring up the inherently low power factor of the melting circuit to about 80 per cent as measured on the incoming power line. The furnace is practically air tight and alloys of all descriptions can be produced free from contamination of any kind.

A paper entitled "The Design and Operation of Vacuum Furnaces with Carbon Resistor Tubes," by Arthur S. King of the Mt. Wilson observatory, was read by Dr. Fink. In this furnace the substance to be examined is introduced into the resistor tube and heated to various temperatures up to 3500° C., under controlled conditions of temperature and pressure. Spectroscopic examinations of the substance are then made. The resulting spectrographs are more nearly free from contaminating influences than has been the case when arc furnaces were used.

Chromium Voltage

By GEORGE B. HOGABOOM

IN nearly every one of the papers published recently on chromium plating, the concentration of the chemicals used, the temperature at which the best character of deposits are obtained and the current density and the pressure employed are explained in detail. In one paper it is advised to use a high voltage when a high cathode current density is required to obtain good covering in deep recesses. The anode current density is entirely neglected.

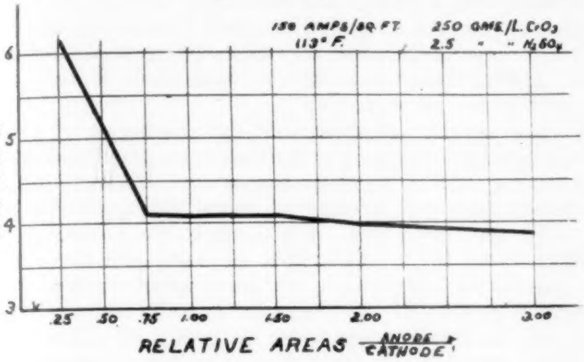

Fig. 1—Showing How Voltage Can Be Decreased as Anode Area is Enlarged

In chromium plating it is advisable to study closely what cathode current densities can be obtained at different pressures by having the anode area greater than that of the cathode. The anodes used, being insoluble, permit a better control than can be had in many other plating solutions. It must not be overlooked, however, that insoluble anodes can also become polarized.

In the early days it was thought that successful chromium plating could not be done unless a 12 volt generator was installed. Later there was much discussion of the advisability of constructing a special 8 volt generator. Today, in many installations, chromium plating is being done at 6 volts pressure and less.

The relation of the anode area to that of the area of the cathode has done much to bring about this condition. In Figure 1 it will be seen that in a 250 grams/litre chromium solution operated at 113° F. and with a current density of 150 amperes/square foot a low voltage can be used if the anode area is larger than that of the cathode.

Brown Finish by Electroplating

Q.—Is there any process to electrically deposit in a plating solution a brown finish on metal articles?

A.—We do not know of any practical solution or method of producing a brown finish by electroplating. The brown finishes on brass, bronze, copper and copper plated metals are produced by the immersion method, usually in solutions containing sulphates or sulphides, supplemented by scratch-brushing to blend to the shade desired. We suggest that you try the following formulæ, one of which may meet your need:

For Brass or Brass Plated Articles—

Aqua ammonia, 26°	1 gal.
Red sulphide of antimony	12 ozs.

Use hot, rinse in cold water, dry and scratch-brush to shade.

Barium sulphide	2 ozs.
Caustic potash	1 oz.
Water	1 gal.

Use hot, rinse dry and scratch-brush dry.

For Bronze Metal or Copper Plated Parts—

Potassium chlorate	1 oz.
Copper sulphate	4 to 5 ozs.
Water	1 gal.

Use hot, rinse dry and scratch-brush dry.

Barium sulphide	2 ozs.
Caustic potash	1 oz.
Water	1 gal.

Use hot, rinse, dry and scratch-brush.

Polysulphide or liver of sulphur	1 oz.
Caustic potash	¾ ozs.
Water	1 gal.

Use cold; rinse, dry and scratch-brush either wet or dry.

Yellow barium sulphide	¾ ozs.
Water	1 gal.

Use hot rinse, dry and scratch-brush dry.

All oxidized finishes require lacquering as preservative.

—WALTER FRAINE.

Tin Plating Rolled Steel

Q.—I am interested in securing all the information possible on continuous electroplating of flat rolled steel with tin. I would greatly appreciate your suggestions as to solution, voltage, amperage and distance between tin anodes to be used.

Do you believe flat rolled strip steel can be successfully plated with tin? Can you obtain a bright finish of tin on material plated? Is it necessary to buff the material in order to secure a finish similar to ordinary tin plate?

A.—Tin can be successfully deposited from a solution of water 1 gallon; sodium stannate 24 oz.; tin chloride ¼ oz.; powdered rosin 1/32 oz.

The solution should be run at 160 to 180° F. Anode distance of 4 to 5 inches is advised. A current density of about 15 amperes per square foot at 2 to 3 volts pressure should be used.

The deposited tin will be a dull grey color. At the present time it is not known how to obtain bright deposits of tin unless very light coatings are acceptable.

It will be found that electrodeposited tin will not give the protection to steel that hot tinning will give. This is probably due to the fact that in hot tinning, that is, dipping steel in molten tin, an alloy is formed with the steel.

It is possible to buff electrodeposited tin to a good color and lustre.

—ELECTROCHEMICAL ENGINEER.

Scientific Plating Control

A New Method of Controlling the Amount of Metal Deposited from Electroplating Baths

By L. C. TURNOCK

President, Turnock Engineering Company, Cleveland, Ohio

A PAPER READ BEFORE ANNUAL CONVENTION OF AMERICAN ELECTRO-PLATERS SOCIETY, JULY 8-11, 1929, AT DETROIT, MICHIGAN

SCIENTIFIC control has become a slogan that is attracting the attention of modern industry. It is the superintendent's insurance of meeting his production schedules promptly with losses through rejections reduced to the minimum. It is the executive's insurance of meeting his responsibility to the stockholders of making the business operate at a profit.

Electroplating is a sizeable industry when considered in the light of its invested capital and man power along with its annual dollar sales. Like every other industry it is one where the adoption of scientific control of its operations has motivated its advancement as an art as well as reflected in its increased earnings as a business.

Progress and achievement in the electroplating art has been rapid during the past fifteen or twenty years. And it can be wholly and directly credited to the fact that a large proportion of those identified with the industry have become more scientific-minded. More intelligent and better scientific control of operations has undoubtedly been responsible for such advancement.

The number of practical improvements brought out to insure the continuous working of any process, with either partial or complete elimination of dependability upon the human control element, is the principal measure of rate of advancement in that industry. Man intelligence is too valuable to be employed to control what an instrument or machine can do more efficiently and effectively.

Achievement with Present Methods of Plating Control

One method of control in the electroplating industry which has been accepted and adopted by many with worthwhile practical results is the chemical control of plating solutions. This has been a logical step forward.

In a number of commercial plants we have installed small chemical laboratories and have devised simple, understandable analytical methods with which we have familiarized the foremen. After a few days' instruction and study the foreman has become competent to check and adjust his own plating solutions to correct standards. The only requirement on his part has been a willingness and desire to learn how to do it. The results in every case have been an immediate reduction or elimination of rejections as well as a marked improvement in quality of the work. Those who do not desire their own control laboratory have available the use of commercial laboratories well equipped to render this service.

A second method of control that has been solved very efficiently concerns the temperature of plating solutions. The market now offers excellent equipment for automatic temperature control of solutions, and certainly no one can deny its effectiveness and reliability over the "finger method" of estimating solution temperatures. We now have dependable electrical instruments to indicate and control the voltage and current to the work in the tanks. We likewise have available reliable clocks to measure and check the time of deposition. We have efficient automatic equipment to convey certain classes of work to be plated in, through and out of the cleaning and plating tanks.

Limitations of Present Methods of Control

When everything is said about present methods applied to controlling plating, however, it seems as though insufficient thought and attention has been directed toward what perhaps is the most important thing of all in plating that really requires control. And that is the actual amount of metal deposited.

It is generally conceded that the deposition of enough metal on the work is the first step toward insuring the underlying metal against corrosion. Present methods of controlling the amount of metal going to the work are (1) the direct one of adjusting the current to the correct value for a whole tank of work and then timing the period of deposition by mechanical means or by mental notations of the clock, or (2) the indirect one of selecting at random one piece or group of pieces of the finished plated work from a certain lot production and determining the amount of the metal deposited thereon by chemical or mechanical means.

Although extensively practiced we may pass over the second or indirect method with the statement

(1) It is entirely unreliable and does not serve as a true index of the amount of metal deposited on the other pieces of work in the lot, in view of the fact that the metal deposited upon the same sized articles or groups of articles being plated simultaneously in the same bath under identical conditions are too much at variance.[1]

(2) The time required to complete such tests is usually so great that in the period elapsed enough additional work has come through production to make the methods really impractical.

The direct method of controlling the amount of metal deposit to the work is open to the criticism that we cannot obtain the same metal deposit to each article or rack of work by leaving all the same kind of work in a tank for the same period of time as noted by a clock. The same value of current does not flow to equal sized articles or racks of work in the same tank. Under commercial conditions current flow to the same size articles or work racks being plated at the same time in the same plating tank is by no means the same.[2] This variation in amount of current flow is due in large part to the differences in contact resistance between the work or work racks and the cathode rods. Under the circumstances it is obvious that no matter how accurately the time of plating may be adhered to we are still bound to obtain a variation in the amount of metal deposit to the work. Even though correct observation of the time of plating would give the desired results, strict adherence to keeping of such time will always be an improbability where the human control element must be relied upon.

Meeting Variations in Metal Deposits

That there is a considerable variation in the amount of metal plated upon the same type of article or groups of articles in the same bath at the same time under supposedly identical conditions is generally known. **The only method we use to combat such a condition is to allow the metal deposit on the greater portion of the work to exceed the standard generally accepted as giving a serviceable life of reasonable duration. We thereby make it possible for the work that would otherwise**

[1] See Tables I, II and III on following pages.
[2] See Tables I, II and III.

receive **an insufficient metal deposit to pass specifications.** By endorsement of such a procedure we are merely closing our eyes to a condition that should and can be corrected.

In a number of plants we have made tests under normal production to determine just what degree of variation there exists in metal deposit when all conditions affecting the amount of deposit such as voltage, tank current, temperature and composition of solutions, and cathode rod and rack hook cleanliness are maintained as nearly identical and perfect as possible. Table I gives the results of observations in one large plant using ten copper plating tanks each having a productive capacity of ten electrotype shells. This method of test was selected because it is

TABLE I

Showing variation in weights of 100 copper shells selected at random from production from ten tanks over a twenty-four hour period. All shells trimmed same size og 10" x 13".

1	16.05	12.60	9.00	11.00
2	10.45	7.90	11.00	9.25
3	5.45	16.20	14.40	11.10
4	7.60	8.95	13.70	8.45
5	10.10	12.80	9.45	11.60
6	12.25	12.10	11.20	12.00
7	9.50	10.60	10.50	10.35
8	10.30	7.85	8.30	8.45
9	9.60	11.50	9.45	10.00
10	9.75	11.60	7.60	11.10
11	10.40	9.55	11.05	8.90
12	9.25	9.45	9.50	11.90
13	11.10	11.35	8.90	9.10
14	4.85	7.60	7.60	9.05
15	9.55	7.50	8.45	8.80
16	8.50	8.80	8.80	10.00
17	9.65	9.55	7.95	8.05
18	7.50	8.00	6.20	9.60
19	8.05	9.15	7.15	6.15
20	8.95	7.10	8.45	8.10
21	7.95	8.35	8.10	7.95
22	8.65	8.00	7.40	6.95
23	7.75	7.50	7.05	5.95
24	11.35	7.30	8.80	8.05
25	8.40	8.75	8.95	10.20

Average weight .... 9.25 ounces
Maximum weight .... 16.20 ounces
Minimum weight .... 4.85 ounces

	OUNCES	PER CENT
Deviation of maximum weight from average weight..	6.95	75.1
Deviation of minimum weight from average weight..	4.40	47.5
Difference between maximum and minimum weights..	11.35	122.6 of av. wgt.

possible in making such shells to strip off completely and weigh the deposited metal without appreciable error. The weights were made on trimmed shells taken at random from each run extending over a production period of twenty-four hours. The variation between the minimum and maximum weight of shells amounted to 11.35 ounces corresponding to 122.6 per cent, whereas the difference between the weight of the heaviest shell and the average of the 100 shells amounted to 6.95 ounces corresponding to 75 per cent. The deviation in weight between the minimum weight shell and the average showed 4.40 ounces equivalent to 47.5 per cent.

Deposits Obtained with and Without Control

The data shown in Table II were obtained from a plant test undertaken to determine how closely the shells could be produced to an exact and uniform thickness when under control, and to make a comparison of shells so produced with those produced under the usual conditions. For this purpose one tank was equipped for controlling the metal deposit to each shell while the other tank of work was allowed to run as usual in accordance with the judgment of the operator.

Prior to the test the solutions in both tanks selected for the run were adjusted to the same temperature and chemical composition. Both tanks were loaded with 10 units of work each and connected in parallel at the same time to the same generator bus potential. The standard aimed at in this plant is a copper shell that will average 0.014 inch in thickness after trimming. In the first tank, under control, adjustment was made to give ten ounce shells after trimming, corresponding to a thickness of 0.014 inch. In the second tank, without control, the work was removed at the end of a period when the operators thought they had shells of the desired thickness. The shells from both tanks were rinsed, stripped from the cases, trimmed, dried, weighed and finally tested for thickness. Table II indicates that all shells produced in the tank under control had the desired weight and thickness, whereas those shells coming from the tank without control varied in weight (thickness) from 11.5 to 15.25 ounces (0.0155 to 0.0215 inch in thickness).

Electrical Control

There are but two factors that directly affect the amount of metal deposited to the work. These are (1) the current flow to the work and (2) the time such current flows—measured as ampere minutes. Should the current flow to the work be higher than normal the time of deposition must be less if the same metal deposit is desired, and vice versa. If therefore we can control simultaneously the current flow and time of such current

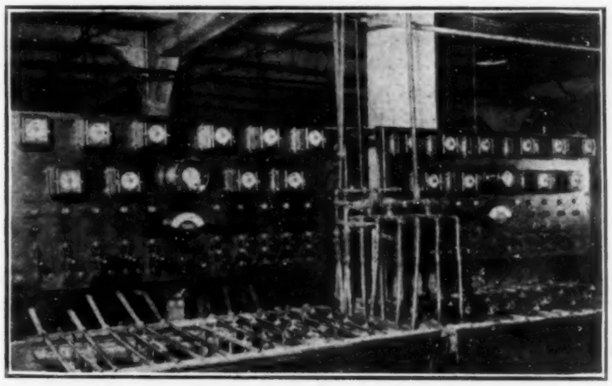

Fig. 1—Two Acid Copper Baths Fully Equipped for Control

flow to any article or rack of work, we can control exactly the amount of metal deposited on such work. This is the fundamental basis of operation of the plating control equipment[3] we have to offer and which has met with commercial success during the year or two it has been in operation. There is really nothing radically new in the method which incorporates a number of well known principles within a single unit and thereby enables the plater to accomplish his work in a more intelligent manner.

In Figure 1 is pictured two acid copper plating tanks

TABLE II

Showing variation in weights and thickness of copper shells obtained without use of control and uniformity possible with use of control. All shells deposited at same time and trimmed to same size before weighing and measuring thickness.

WITHOUT CONTROL			WITH CONTROL		
Number of Shell	Weight Trimmed **Shell** Ounces	Thickness of **Shell** Inch	Number of Shell	Weight Trimmed **Shell** Ounces	Thickness of **Shell** Inch
1	15	0.022	11	10.0	0.014
2	12	0.017	12	10.0	0.014
3	13	0.0205	13	10.1	0.014
4	14.5	0.022	14	9.9	0.014
5	11.5	0.0155	15	10.0	0.014
6	14.0	0.0165	16	10.0	0.014
7	15.25	0.0215	17	10.0	0.014
8	13.5	0.0185	18	10.1	0.014
9	13.0	0.018	19	10.1	0.014
10	14.5	0.0195	20	10.0	0.014

[3] U. S. Patents 1,527,095 and 1,712,284 and others pending.

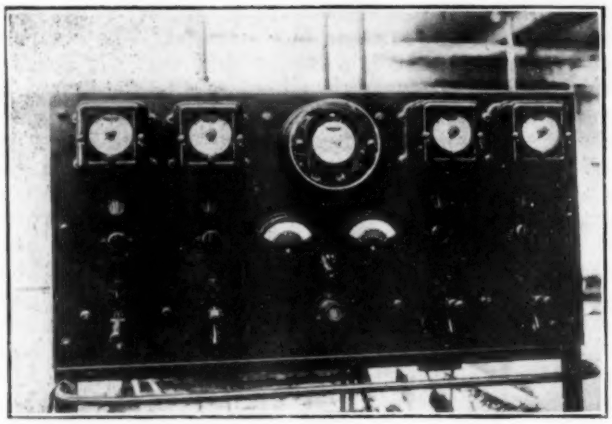

Fig. 2—Four-Unit Panel for Gold or Silver Baths

each equipped with ten cathode rods and one ten-unit control panel. In each cathode rod circuit is connected a control meter calibrated in the proper metal units, a red and green signal light and a single-pole double-throw operating switch. When the switch is closed upward the circuit is connected directly to the negative bus line. By closing the switch downward the circuit is completed to negative bus through the metal deposition rate meter shown in the lower center of each control panel.

The operation of the control panel is quite simple. The actuating hand of the control meter operating on any cathode rod circuit is first set at zero. Next the auxiliary hand of the same meter is turned on the dial to the metal deposit desired on the work hung from that particular cathode rod. The work is now suspended from the cathode rod and the switch corresponding to that circuit is closed upward. At the same time the green light comes on indicating that circuit in operation. In like manner the procedure is repeated by suspending work from the other cathode rods until the tank is completely loaded.

As the metal deposits on the work the hand of the control meter moves forward in a clockwise direction indicating at a glance exactly what amount of metal has already been deposited on the work and what amount remains to be deposited. When the deposition of metal to the work is complete the operating hand of the control meter engages the indicating hand and flashes a red light signaling the operator to that effect. Where desired it is possible to make the circuit open automatically when the plating is complete.

Since each cathode circuit in a tank is controlled independently of the other cathode circuits in the same tank, it is neither necessary to place all the work in the tank at the same time nor to keep any record of time and current to the work suspended from the different cathode rods. The control meters serve that purpose and automatically integrate the time and current which are the only factors directly affecting the weight of metal deposited.

Different classes of work requiring different amounts of metal deposit may be plated with accuracy in the same tank at the same time.

If you desire to know the rate at which metal is being deposited to each cathode rod of work at any instant (in ounces, pennyweights or any other weight units per hour), all that is required is to first open and then close downward the switch controlling that particular cathode circuit. Reading is made on the metal deposition rate meter shown in the lower center of the panels in Figure 1. This meter has a double scale, one reading in amperes and the other in weight units of metal deposited per hour. To many platers the metal scale has more significance and is more appreciated than the ampere scale.

Rarely in production will it be found that the control meters on a panel serving a single tank advance at the same rate. Frequently the work suspended from the fourth and fifth cathode rods will receive their deposit and be ready to come out before the work put in the bath first and suspended from the first rod. In such cases the deposition rate meter will of course indicate a faster rate of metal deposit to the work suspended from the fourth and fifth cathode rods. When such a condition is encountered it will as a rule be found to be due to the effectiveness of the electrical contacts between the work and cathode rod or between adjacent anodes and anode rods. The deposition rate meter therefore serves as a valuable indicator of faulty electrical contacts between the work and work rods.

As the work is removed from any cathode rod it requires but a moment to reset the control meter to zero on that particular circuit. That cathode rod is now ready to receive additional work. With individual cathode rod control it is not necessary to empty the whole tank of work before refilling it with new work in accordance with the usual practice. Where the procedure calls for one unit or rack of work at a time to be cleaned, struck and suspended in the plating tank it is obvious that individual control of the cathode rods or circuits will materially increase the productive capacity of the plating tanks. With the installation of a six unit control panel on one tank for a large silver plating concern it was possible to increase the tank productive capacity by thirty-five per cent.

Since each control meter is reset to zero before starting the plating of a new rack of work the record of metal deposited would normally be lost. To maintain such a record a totalizing meter is installed on each panel. This is illustrated as the round meter in the upper center portion of the panels shown in Figure 1. The totalizing meter is read like any electric or gas meter and keeps a permanent record of all metal deposited to the work suspended from the cathode rods. It also serves the useful purpose of helping maintain the metal inventory.

Control Units for Gold, Silver and Nickel

Figure 2 illustrates a four-unit panel designed for gold or silver plating. In addition to four control meters, which may be used individually on small work or collectively on larger work in the same tank, a totalizing meter, and metal deposition rate meter the panel is equipped with a rheostat with fine step control, a voltmeter, and a voltmeter switch by means of which it is possible to observe either the line or tank voltage. With a control panel of this character the plater has everything he needs to insure uniformity of plate and strict adherence to his standards of plate.

Figure 3 illustrates a two-unit control panel designed to handle the work of a double cathode rod tank.

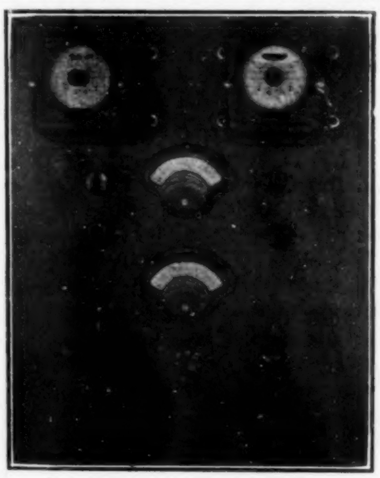

Fig. 3—A Two-Unit Control Panel Designed to Operate on a Double Cathode Rod Tank

TABLE III

Showing variation of silver plate received by band instruments when plated four at a time in same tank, also accuracy of silver plate received by instrument when subject to individual control. All instruments of same size placed in plating tank at same time.

Instrument No.	Location in Plating Tank	Weight of Instruments: Before Plating OZ Troy	DWT	Grains	After Plating OZ Troy	DWT	Grains	Silver Deposited DWT	Grains	Difference from Anticipated Deposit of Silver Metal Grains	Per Cent
I	On separate cathode rod and control meter, set to give deposit of 10 DWT silver	36	19	0	37	9	2	10	2	2	0.83
II	All four instruments on same cathode rod distinct from	36	7	9	37	0	5	12	20	64	26.7
III	first instrument. Controlled all together by separate	36	0	0	36	8	12	8	12	—36	—15.0
IV	control meter set to give a combined deposit of 40 DWT	36	9	21	36	18	23	9	2	—22	— 9.15
V	of silver	35	18	3	36	7	23	9	20	— 4	— 1.66

Table III contains the operating data observed with the use of a two-unit control panel on a double cathode rod tank employed to silver plate saxophones. The standard aimed at in this plant was a silver deposit of ten pennyweights to the particular sized saxophones used in the test. One instrument by itself was suspended from one cathode rod in the tank and the control meter functioning on that rod set to give a silver deposit of ten pennyweights. From the second cathode rod in the tank was suspended four instruments of the same size as the first. The control meter operating on the second cathode rod was set to give a total deposit of forty pennyweights of silver. The five instruments were carefully weighed before and after receiving their deposit of silver.

Reference to Table III will indicate that the instrument suspended from the first cathode rod received its proper weight of silver, whereas there was a considerable variation in weight of silver deposited on the four instruments suspended as a group from the second cathode rod. However, the combined weights of the silver metal deposited to all four instruments suspended from the second cathode rod checked within experimental error of the forty pennyweights of silver at which the control meter was set.

Tangible Investment Return

Table IV gives an analysis of savings, equivalent to an investment return of over fifty per cent, experienced with the control equipment shown in Figure 1 during the first year of its use.

It is generally assumed with the maintenance of constant voltage across a plating tank that the current flow to the different pieces of work suspended in the same tank is directly proportional to the exposed surface areas of the different pieces of work. The use of control panels in commercial production have shown this assumption to be erroneous. The metal deposition rate meters on the control panels have indicated a variation in practice of from fifteen to fifty per cent in the current flow to six or more articles of the same size and shape suspended from separate cathode rods in the same tank. The anode location with respect to the cathodes was made as nearly uniform as possible before the current flow readings to the different cathode rods were taken.

To insure the same metal deposit to each piece of work in the tank with such variation in current flow to each piece of work, it would be necessary to change the time of plating to a correspondingly greater or lesser amount. Any such procedure would of course be impracticable even though we did have the means of knowing exactly the current flow to the different cathode rods. However, with control meters that automatically integrate any variations in current flow to the work and automatically taken into account the proper time of deposition it is possible for the plater to adhere strictly to definite standards of plate and acquire the mental insurance that the metal deposit on his work will be uniform in weight.

Panels for controlling metal deposits can be designed to handle all metals such as copper, nickel, chromium, gold, silver, tin, lead, zinc, and so on. They may he had in any size units and be equipped with or without totalizing meters. Their attachment to the plating tank will not interfere in any way with putting the work into or taking it out of the tank. The cathode rods may be divided electrically in accordance with the number of separate circuits in each rod, and all wires leading to the control meters may be carried inside of the cathode rods. In this way there need be no change in the space arrangement or number of cathode rods.

Figure 4 shows a view of two double unit controls operating on chromium and employed to control the deposition of chromium to printing plates. Direction charts located on the panels quickly indicate to the operator the proper setting of his control meters to obtain uniform deposits of chromium on different sizes of plates.

Plating control equipment of this character affords a simple and automatic means of adhering to definite standards of plate once such standards are agreed upon and accepted. It will eliminate the guesswork in plating

TABLE IV.

Showing an analysis of savings made in first year thru use of plating control in effecting standardization and regulation of weight of copper shells.

Savings in Metal	
Total copper metal deposited to work as recorded by totalizing meters	20,600 lbs.
Number of shells produced in year with control ...	30,000
Average weight of copper shells before installation of control, based on an inspection of 200 shells taken at random from a production of four days, and varying in weight from 8.5 oz. to 16.35 oz.	14 oz.
Standardization of shell weight after installation of control	11 oz.
Total copper metal saved during year thru standardization (3 oz. per shell)	5,625 lbs.
Monetary savings in copper metal (at 18c per lb.)	$1,012.50
Savings in Electrical Energy	
On basis of 100 amperehours depositing 4.18 oz. of copper, potential per tank equal to 3.5 volts, overall efficiency of motor-generator set equal to 70%, energy cost at 4c per kilowatt hour, cost of depositing this excess of 5,625 lbs. of copper would be	$ 377.00
Savings thru Reduction in Losses	
TOTAL TANGIBLE SAVINGS IN FIRST YEAR	$2,014.50
Previous year's losses were 125 units at a material and labor cost of $5.00 each	$ 625.00
an amount representing an investment return on the installed cost of the equipment of more than fifty per cent in the first year.	

and offer the plater an accurate and intelligent means for fulfilling his obligation of producing quality work at minimum cost.

Consideration Due the Buyer of Plated Ware

The time is rapidly approaching when the buyer of plated ware is going to exercise his right to **demand** that he be **shown** he is receiving uniformly plated work, and that **all** the plated work he purchases receives the definite standards of metal coating that will insure the serviceable life he is entitled to expect. He is not interested in expending his thought and attention on how you are going to convince him of that fact. That is your problem. You would not think it reasonable if your butcher expected you to bring along your own scales when buying his products.

Giving the buyer of plated ware a heavier metal coating than necessary in order to assure yourself that all his work is receiving enough metal deposit is bound to reflect in lower profits from your business, since to the metal loss you sustain there must be added a corresponding loss in electrical energy and also in tank productive time.

Science teaches accuracy—discourages guessing.

Fig. 4—Two Double Unit Controls Operating on Chromium Tanks Used for Plating Printing Plates

Senate Revision of Tariff Schedules on Metals

ACCORDING to the daily press, the following is a part of a report given by Senator Reed Smoot on the tariff rate revisions made by the Senate Finance Committee Republicans, who comprise the majority of the Committee. We give schedule 3 devoted to metals and their manufactures.

"This schedule comprises ninety-nine paragraphs, many of which provide for a great number of diverse products and industries. Most paragraphs provide for products or groups of products which bear little economic relation to the products in other paragraphs of the schedule, so that the diversity of factors to be considered in providing adequate phraseology and rates is vast.

"Since the passage of H. R. 2667 much new information has become available which in a considerable number of paragraphs permits more accurate evaluation of competitive conditions than was possible by the House of Representatives. Consequently a substantial number of revisions have been made in the House bill with a view to clarifying the language, facilitating administration of the act, and making adjustments in rates. The committee's changes of the House bill effect in this schedule about forty upward revisions of individual rates and over sixty downward revisions, including items transferred to or from the free list.

"Items transferred to the free list were: Manganese ore, muzzle-loading firearms, hoes, rakes, metal parts of typewriters, zinc dross, zinc skinnings, and nickel oxide. Articles made dutiable were: Cream separators valued at more than $40, but not more than $50 each, and milk cans. Certain items were specifically mentioned to avoid litigation over classification, or to effect changes in the rates now imposed, and to provide separate statistical classifications.

"A tentative calculation shows that the result of the readjustment is an equivalent ad valorem rate for Schedule 3 based on imports during 1928 and taking into account transfers to and from the free schedule of about 33 per cent.

"This compares with an equivalent ad valorem of 39.6 per cent in the House bill and 35.07 per cent when the rates of the tariff act of 1922 are applied. The decrease in revenue in the present bill from the House bill is about 17 per cent and from the act of 1922 about 6 per cent."

THE METAL INDUSTRY

With Which Are Incorporated

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Editorial

The Copper Situation

EVER since its flight of several months ago in which it skyrocketed to 24 cents and fell back again to about 18 cents per pound, copper has been steady with a tendency toward heaviness. A few weeks ago, due to the placing of large orders by interests who had held off a little too long, there was renewed agitation for a rise, but it died away rapidly. The conditon now seems to be that the producers are glad to hold to the 18-cent price, asking for no rises and hoping for no falls. In this, they are unquestionably wise as 18 cents a pound for copper means very handsome profits all around. The price of the metal really now depends upon the consumers. If they will order steadily, as they need it, and not order too heavily to "protect" themselves or to delay too long on a gamble, the market will be steady. And that is most of the battle as far as consumers are concerned.

Surveys by the Copper and Brass Research Association shed some light on the prospects of copper consumption for the coming year. Based on the usual rate of depreciation of buildings, the average fire and storm losses, the increasing population and the need for new construction, this Association estimated the total building requirements for 1929 at about $8,500,000,000 (see the editorial on the building trades in our issue of February, 1929, page 88). This estimate cannot be checked, of course, until some time after the end of the year. It is less than that for 1928, and the final records will probably prove that building has dropped off, perhaps 10 per cent. However, the consumption of copper in buildings has probably risen, due to the new uses developed for it, such as brass piping and the fact that copper has gone into a large amount of replacement work, thus offsetting the drop in new construction.

In shipbuilding, it is stated, a modern 30,000-ton ship may be as much as one tenth copper, if all appropriate parts are made of that metal or its alloys. Prospective building programs indicate a construction of 3,000,000 tons of marine shipping per year, and the possibility of the construction of 1,700,000 tons for navies. As regards the latter figure, however, there may be a very heavy cutting.

It may be that the consumption of copper for 1929 will be higher than 1928. No one attempts to predict any further than the end of the year, but it seems that the price situation is fairly well in hand unless consumers lose control of themselves.

The Position of Tin

A METAL which is being watched at this time with more than usual interest is tin. During 1928, the United States consumed over 73,000 tons of primary tin, about 7.5 per cent more than 1927, according to the U. S. Bureau of Mines. At the same time, according to reports from the National Metal Exchange, deliveries of tin in the United States for the first nine months of 1929 have totaled over 70,000 tons, indicating deliveries of 93,000 tons for the entire year; far above all past records.

It is of interest to note the proportions that the various tin consuming products take of the total consumption:

Tinplate and terne plate about	37	per cent
Solder	18.5	"
Babbitt	11	"
Bronze	6	"
Foil	7	"
Collapsible tubes	4	"
Chemicals	6	"
Tin oxide	1.5	"
Tinned, brass and copper products	3.5	"
White metal	1	"
Type metal	.5	"
Castings	1	"
Miscellaneous	3	"

The secondary tin business is known to be large. The greatest single use for secondary tin is in solder, about 4,500 tons being consumed by this product in 1928; the babbitt output, 2,200 tons; bronze, 1,000 tons; chemicals, 1,000 tons; Type metal, 900 tons; and white metal 800 tons.

Analysis seems to show that the consumption of tin has grown along with the growth in the basic tin-consuming industries. No other outlets of importance have appeared. At the same time, production and deliveries of tin continue to be extremely heavy. In addition we have the fact that in several of these important lines, tin has met serious competition.

In the canning industry, glass and paper for containers are beginning to be used as substitutes. Aluminum is making headway as a substitute for tinplate wear. Non-metallic products as well as zinc, copper and zinc coated roofing have undoubtedly supplanted some tin and terne plate used for roofing, siding, etc. The growing practice of lap-welding and die stamping tin cans has lessened the demand for solder in canning operations. The practice of "wiping" joints with solder by plumbers is now practically abandoned, and cadmium has been reported to be a satisfactory substitute for tin in some solders.

Aluminum is becoming important in the collapsible tube and foil industry, as is also a transparent cellulose product called "cellophane," now being used for wrapping confections.

The fairness of the present price of tin is an open subject for debate. It is certain, however, that before it can move appreciably upward, the tin industry will have to develop new important outlets or decrease production.

A New Metal on the Horizon

THE engineering and industrial world is now more than ever awake to the utility and possibilities of non-ferrous metals. Even the general public knows that copper and brass are higher grade materials than iron, and that chromium gives a beautiful and durable plate. Consequently, we have as never before, a feverish searching after new possibilities; searching by those engaged in the manufacture of known metals for new uses and outlets; searching by others for new metals with the possibility of developing like aluminum.

Within the last few years we have seen magnesium, cadmium and chromium raise their heads, and now we can sight two other metals, tantalum and beryllium.

Both of these metals are still young so far as production is concerned, but they have properties which beckon to all those with the courage and financial strength to investigate.

Tantalum, it is predicted, may replace platinum for industrial uses, and if it should do so in time, and the price of platinum be consequently reduced, who knows but that platinum will lose its popularity for jewelry. It will be too cheap! Beryllium seems to have caught our fancy as few other metals have done. It has about the same specific gravity as magnesium, being about 30 per cent lighter than aluminum, but its modulus of elasticity is almost as high as that of steel. It is stated that an alloy of 70 per cent beryllium and 30 per cent magnesium can be made with a tensile strength of over 70,000 pounds per square inch.

Clearly enough the first outlet for a material of this kind is in aircraft.

At its present price, little beryllium will be used, as even with all the margin in the world, no plane builder will spend $200 a pound for materials in any quantity. However, the $200 figure means nothing if a real production program can be developed. Fifty dollars a pound is probably a safe estimate and at this price, a fair amount of beryllium may be sold to those to whom its extremely light weight and strength are important.

Aluminum, the beacon light which draws everyone toward new metals, has a history of about thirty-five years of struggle behind it. Its original price was also very high.

While no one would be rash enough to predict a similar future for any other metals, there is no doubt that such materials as beryllium, tantalum, cadmium and chromium have a sphere of usefulness of considerable size.

And these metals can, with patience and sufficient resources, be built up to a profitable program of exploitation.

Bus Bars Across the Sea

IN these days of co-operation between English-speaking peoples, it is an added pleasure to be able to point to the fact that electroplating is abreast of the times. Dr. A. B. Sanigar of Sheffield, England, has been awarded the Weston Fellowship of the American Electrochemical Society, and he will work in the United States at Columbia University, New York, under Dr. Colin G. Fink, on problems in silverplating.

We are doubly honored in this choice. England is the birthplace of silver plating, and now England is sending one of its foremost research men to study our country.

Edward Weston, donor of the Fellowship, came to the United States from England and worked on electroplating.

He was the first to discover the benefits of boric acid in nickel solutions and his discovery is still in use. He founded and built up the Weston Electric Instrument Company which makes voltmeters and ammeters for use in electroplating.

Dr. Sanigar is a distinguished representative of the English plating industries. It was a graceful act of the American Electroplaters' Society to award him the first Weston Fellowship, as in so doing the Society honored not only him, but itself, and did its share toward cementing the friendship of Great Britain and the United States.

How Is Business?

"HOW'S BUSINESS?" is the question asked, answered and argued about in cities, just as the weather is the topic of conversation in town and country. There have been few periods when industrial activity was so sustained and high as at the present time. Steel is being produced at about 90 per cent capacity. Railroad freight car loadings are higher than in the previous year. Up to this time coal production has been good. Railway equipment buying has staged a recovery. Copper continues to be steady.

The list of active and properous lines of industry and commerce could be extended considerably.

It is well to note, however, that there is a perceptible tendency to slow down a little. The motor industry, after having established records, probably due to Ford's recovery, is beginning to lag and it is this condition which business is watching rather anxiously.

Most observers continue to be quite optimistic on the business prospects for the fall.

There seems to be little fear of a long slump. In general, it seems to be the opinion that this let-down is temporary, perhaps caused by the unprecedented rush of the summer, and a natural reaction. It is always possible, however, to consider this explanation the thought which is fathered by the wish.

All signs now will be watched with the closest of attention, day by day. If the fall is good, there will be hopes for a good spring.

If the fall is disappointing, there may be hesitation and doubts which will do as much to retard business as any real obstacles.

Correspondence and Discussion

Aluminum Poisoning

To the Editor of THE METAL INDUSTRY:

We note an article on aluminum poisoning in your September issue, and would like to relate a case wherein such poisoning was brought to our attention some years ago.

A prominent physician of Milwaukee, Wis., wrote us with reference to a patient who had contracted aluminum poisoning. The patient was a buffer in one of the large aluminum plants at Manitowoc, Wis. The case attracted considerable attention, due to the fact that the man had become totally paralyzed. Other physicians who had handled the case declared the patient totally disabled and as it was an insurance case, the patient was sent to Dr. B. B. Rowley for examination, and after careful diagnosis he found that the patient was suffering from aluminum poisoning, which was brought on by the absorption through the skin of the finely powdered aluminum.

Dr. Rowley wrote us that he had gone through the libraries in Milwaukee and also Madison, but was unable to find anything pertaining to aluminum poisoning in the text books and inquired of us whether we knew of any treatment for this affliction. We recommended the use of citrate of potash in ten grain doses to be taken three times a day, and also that the patient drink plenty of milk. We learned from Dr. Rowley some time later that the patient had fully recovered and was back on the job.

To prevent absorption of aluminum dust by workers, especially the buffers, they should grease their arms with vaseline.

Trusting the above information will be the means of assisting some other poor unfortunaates, we are

KREMBS AND COMPANY.

Technical Papers

Rolling-Mill Rolls—A Bibliography. By Victor S. Polansky of the Carnegie Library of Pittsburgh, Pa.

This bibliography is devoted to the design and manufacture of rolls prior to being put into service in the rolling mill. References to patents are limited to mention of the classes of American, British and German patent offices without attempting to list the individual patents. Material on failures, chiefly in service, is included because these are often due to faulty manufacture or composition.

Abstracts of Scientific and Technical Publications From the Massachusetts Institute of Technology, Cambridge, Mass., July 1st, 1928—December 31st, 1928.

This book lists abstracts of the publications of the Massachusetts Institute on the following subjects: aeronautical engineering; biology and public health; chemical engineering; chemistry; civil and sanitary engineering; economics; electrical engineering; geology; mathematics; mechanical engineering; military science; mining and metallurgy; naval architecture and marine engineering; physics.

Report of the National Screw Thread Commission. Bureau of Standards Miscellaneous Publication No. 89. (Revised 1928.) Price 50 cents.

X-rays in Industry. Methods of Applying X-rays to Metals and Metal Products. Issued by Eastman Kodax Company, Rochester, N. Y.

Precipitation of Lead and Copper from Solution on Sponge **Iron.** Bureau of Mines. Bulletin No. 281. Price 35 cents.

A List of the Books, Bulletins, Journal Contributions and **Patents By Members of Mellon Institute of Industrial** Re**search, During the Calendar Year 1928.** Bibliographic Series, Second Supplement to Bulletin No. 2.

Reduction of Cuprous Oxide by Carbon Monoxide. Bureau **of Mines,** Reports of Investigations No. 2926. By Charles G. Maier.

Automatic Plating Machinery, by Edwin M. Baker. Industrial and Engineering Chemistry, May 1929, pages 400-404.

Thermal Expansion of Tantalum. By Peter Hidnert. Bureau of Standards. Research Paper No. 62. Price 5 cents.

Studies in Metal Crystal Orientation. 1. Determination of Orientation of Metallic Single-crystal Specimens by High-voltage X-rays. By Thomas A. Wilson, Schenectady, N. Y. Technical Publication No. 210, American Institute of Mining and Metallurgical Engineers, New York.

The Passivity of Metals and Its Relation to Problems of **Corrosion.** By Ulick R. Evans, Cambridge, England. Technical Publication No. 205. The American Institute of Mining and Metallurgical Engineers, New York.

Government Publications

Publications listed hereunder are obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., at the prices given, unless otherwise noted.

Mineral Resources of the United States in 1928. By F. J. Katz and Martha B. Clark. Bureau of Mines, Department of Commerce. Preliminary summary giving plan of the forthcoming complete report and summaries of statistics on all metals and minerals. Price, 20 cents.

Report of The National Committee on Calendar Simplification for the United States. Published by the Committee, 343 State Street, Rochester, N. Y., where it is obtainable on request to the chairman. The report was submitted to the Secretary of State, Washington, D. C., and fully describes various aspects of the question of calendar simplification.

Copper in 1927. By C. E. Julihn and Helena M. Meyer. Bureau of Mines, Department of Commerce. General report; comprises pages 677-729 of "Mineral Resources of the United States, 1927—Part I." Price, 10 cents.

Standard Government Form of Invitation for Bids. General Purchasing Officer, The Panama Canal, Washington, D. C. Supply contract form; samples obtainable from above officer at Washington.

Proposed Specification for Padlocks. Federal Specifications Board, United States Government, Washington, D. C. Copies of these proposed specifications free on request to the Board who should be addressed in care of the United States Bureau of Standards, Washington, D. C.

New Book on Chromium Plating

Electroplating with Chromium and Other Metals, by B. Freeman and F. G. Hoppe. Published by Prentice-Hall, Inc., New York. Price, $5. This book will be obtainable from THE METAL INDUSTRY, publication being promised for early November.

Publisher's announcement of this book states that it will be a practical manual covering such questions as types of racks for chromium work, cleaning processes for base metals, copper plating solutions, overcoming flaws in nickel plating, polishing methods, for chromium as well as other deposits.

Shop Problems

This Department Will Answer Questions Relating to Shop Practice.

Altering Nickel Solution

Q.—I am sending you a sample of nickel solution for analysis. This solution gives us trouble every now and then. We use it for all kinds of work—brass, iron, steel, aluminum die castings, etc. It is operated in 130-gallon tank. When new it worked fine, but after 6 or 8 weeks it began to give trouble. After plating a few pieces in it the wires became black, as though covered with a dust. The coating will brush off but where the wires come in contact with the work a black mark appears, and the deposit does not cover that mark. When the solution works well on the aluminum it will not work on the other metals. Do you think the iron has a bad effect on the solution?

A.—Analysis of nickel solution:

Metallic nickel	4.25 oz.
Chloride, as ammonium chloride	6.01 oz.
pH	6.4

The solution is too high in metal and chloride content and the pH is also too high. We suggest that you reduce the solution one-third and replenish with water. Do not add any more chloride for some time as it is this factor, with the high pH, that causes the work wire to plate a dark color.

A formula that should give you good results is as follows:

Double nickel salts	8 oz.
Single nickel salts	4 oz.
Ammonium chloride	2 oz.
Boric acid	2 oz.
Water	1 gal.

—O. J. S., Problem 3,891.

Black Dip for Swivels

Q.—Can you furnish us with a formula to black dip small brass swivels such as the sample we are sending you herewith.

The dip we are now using does not color these articles evenly and requires a great deal of time.

A.—The class of work you are doing is usually plated in a black nickel solution to obtain a black finish. You can also produce a black finish by using the following immersion formula:

Carbonate copper	1 lb.
Ammonium hydroxide, 26°	1 quart
Water	2 quarts

Add the water after the copper carbonate and ammonium hydroxide have been thoroughly mixed. Use at a temperature of 175° F. There must be at all times an excess of carbonate of copper or results will be poor.

The samples you sent were finished in the above solution.

—O. J. S., Problem 3,892.

Bronze Finish

Q.—I am sending a sample herewith of a finish which I would like to duplicate. Can you tell me how this is done?

A.—Sample has been finished as follows: Plate in acid copper solution for 15 minutes; rinse thoroughly in clean cold water and immerse in bronzing solution made of ½ oz. yellow barium sulphide, ½ oz. (fluid) of liquid sulphur, 1 gallon water. Dry and scratch brush on a brass crimped wire wheel operated at 800 to 1,000 R.P.M.

The length of time of immersion in the bronzing solution will have to be determined by experimenting. About 30 seconds would do for this particular shade of bronze. Finally, lacquer by spraying.

—O. J. S., Problem 3,893.

Cadmium and Chromium Solutions

Q.—I would like to have information on cadmium plating. I wish to run a 100-gallon tank. Please state current and temperature required, cleaning process before plating and ingredients of plating solution.

If it is not too much trouble, please give me similar advice as to a chromium solution.

A.—Formula for cadmium solution:

Sodium cyanide	9 oz.
Cadmium oxide	3 oz.
Caustic soda	2 oz.
Water	1 gal.

Temperature, 90° to 95° F. Cathode current density, 15 to 20 amperes per square foot. Voltage, 2 to 4.

No different cleansing methods are used to prepare the work for cadmium plating than for other alkaline plating solutions.

Formula for chromium solution:

Chromic acid	55 oz.
Sulphuric acid	0.3 oz.
Water	1 gal.

Temperature, 90° to 95° F. Cathode current density, 35 to 50 amperes per square foot. Use lead anodes.

—O. J. S., Problem 3,894

Excessive Tri-Valent Chromium

Q.—I am sending you a sample of a chromium solution of which I have just been placed in charge. I understand the previous plater on the job could not make it work properly, although he installed it, with the help of the plating supply house that sold the equipment. The same supply house informed me that the ingredients were one gallon water, 50 oz. chromic acid and 2 oz. chromic sulphate. Lead anodes were supplied. I discovered a bottle of chromic carbonate here, however, and suspect that this was used in the solution by the plater despite the supply firm's directions.

In plating small, polished brass pieces, the chromium plate came out fine. I used about 6 volts and gave it about 500 amperes per square foot for about a minute and then cut down the amperage to about 125. I tried this on some headlight rims which I first buffed, nickeled and buffed again. These came out poor. They were dull around the edges, where there was a kind of thick deposit. The deep surface came out bright with hardly any deposit. I buffed the rims and the grey deposits brightened up pretty well. I have tried plating tubes and bumperettes in the solution. I can get a deposit by pretty involved manipulation of the work in the tank but it is never very good. Can you tell me where the trouble is?

What are some good books on plating?

A.—Analysis of chromium solution:

Chromic acid	49.7 oz.
Tri-valent chromium	1.77 oz.
Sulphate	1.14 oz.

Solution is high in tri-valent chromium and sulphate. The poor

throwing power is due to these two factors. We suggest that you reduce the tri-valent chromium in the solution by the porous pot method. Add enough barium chromate to precipitate all the sulphates and then add the proper amount of sulphuric acid, which, in this particular solution, would be 0.4 oz. by weight, per gallon.

The heavy deposit that you get on the end of the cathode is due to excessive current density. You will be compelled to do a little experimenting before the proper temperature and current density are found. In general a temperature of 95° to 100°F., with a cathode current density of 50 to 75 amperes per square foot, are being used to good advantage with the type of solution you will have after the suggested corrections have been made.

Electroplating and Electroforming by Blum and Hogaboom, and Langbein's **Electrodeposition of Metals** are two good books on plating. —O. J. S., Problem 3,895.

Low Chloride in Nickel Solution

Q.—We are sending you a small bottle of nickel solution, the product of which peels a short time after application. We believe it to be brittle, and would appreciate your opinion of it, its faults, and information to improve it.

A.—Analysis of nickel solution:

Metallic nickel	2.51 oz.
Chlorides	.28 oz.
pH	5.6

Solution is low in chlorides and the pH is also too low, especially if chromium is to be deposited over the nickel deposit. We suggest the addition of 2 oz. ammonium chloride to each gallon of solution. Also add 6 oz. of 26° ammonium hydroxide to each 100 gallons of solution.

We also suggest that this solution be operated at a temperature of 110°F.

—O. J. S., Problem 3,896.

Nickel Solution with Low pH

Q.—I am using a 200 gallon nickel solution made up of double nickel salts which I have had in constant operation for two years with good success. From time to time I have added single nickel salts and a few drops of sulphuric acid. I began to use 99%-plus nickel anodes some time ago. Lately the deposition has been kind of slow and I have had to step up the voltage to get results. The anodes are creased from end to end and somewhat discolored. I am sending a sample of the solution for analysis.

I think the single nickel salt additions have thrown the solution out of balance, but as I am a very poor chemist I cannot tell just what is wrong.

A.—Analysis of nickel solution:

Metallic nickel	2.15 oz.
Chlorides	0.28 oz.
pH	5.4

The pH of the solution is too low for ordinary work. Add 6 oz. of 26° ammonium hydroxide to each 100 gallons of solution.

The chloride content of the solution is very low, no less than 2 oz. per gallon being used for proper corrosion of 99%-plus nickel anodes. Add 2 oz. ammonium chloride and 2 oz. boric acid to each gallon of solution and you will notice an improvement in the condition of the anodes and also the deposit.

—O. J. S., Problem 3,897.

Silver, Nickel and Copper Solutions

Q.—Under separate cover we are sending 2 oz. samples of my silver, nickel and copper solutions. We would like you to tell us what may be lacking in them to bring them up to strength.

The silver solution runs a little brassy and is rather hard to buff. We added some silver chloride recently. The copper solution runs kind of brown and the anodes do not clean very well. The nickel solution runs sort of dirty grey. We would like to know the acidity and also the metallic content. Would it be advisable to add nickel chloride to the nickel solution?

A.—Analysis of silver solution:

Metallic silver	1.06 oz., Troy
Free cyanide	1.09 oz.
Carbonates	2.66 oz.

The silver solution is low in metal and free cyanide. Add 1½ oz. of silver cyanide and 3 oz. of sodium cyanide to each gallon of solution.

Analysis of cyanide copper solution:

Metallic copper	1.84 oz.
Carbonates	5.05 oz.
Free cyanide	0.40 oz.

This solution is low in metal and free cyanide. Add 2 oz. sodium cyanide and 1 oz. copper cyanide to each gallon of solution. Also add 1 oz. hyposulphite of soda to each 100 gallons of solution. If solution is operated at a temperature of 110° F., best results will be obtained.

Analysis of nickel solution:

Metallic nickel	2.14 oz.
Chlorides	0.71 oz.
pH	5.6

Solution is low in chloride content. Add 2 oz. of ammonium chloride to each gallon of solution —O. J. S., Problem 3,898.

Silver on Stainless Steel

Q.—Please publish a formula for silver plating stainless steel table knives.

A.—Stainless steel knives can be silver plated by using an electrolytic pickle after the cleaning operations. For the pickle use a 25% hydrochloric acid solution with direct current.

Rinse in clean cold water and plate in silver strike composed of 10 oz. sodium cyanide, ¼ oz. silver cyanide, water 1 gallon.

After this special strike, use regular strike of sodium cyanide 6 oz., silver cyanide ½ oz., water 1 gallon, then plate in regular silver solution. —O. J. S., Problem 3,899.

Testing for Potassium Cyanide Content

Q.—Will you kindly send us a formula for mixing a solution to test the amount of potassium cyanide (KCN) in a silver plating bath?

A.—The volumetric method for determining the free cyanide in a silver solution is as follows:

Make a deci-normal solution of silver nitrate by weighing accurately 17 grams of C.P. silver nitrate; dissolve in distilled water and make to exactly 1 liter.

Take 10 cc. of the plating solution, dilute to 100 cc. with water, add 5 drops of a 10% potassium chromate solution and titrate with the silver nitrate solution until a faint cloudiness persists. Calculations:

The number of cc. of silver nitrate used x .098 x 13.3 equals ounces of free potassium cyanide per gallon of solution.

—O. J. S., Problem 3,900.

Tinning by Immersion

Q.—Will you please give some formula for tin dipping without the aid of electric current. I would like a formula which would allow the use of a metal basket and which would plate very small brass articles and chains. Also state whether or not this would work if used on steel parts.

A.—There are two methods in use for tinning small brass articles by the immersion process.

The cream of tartar process consists of placing the work, which must be clean and bright, in a copper container and boiling for 2 to 5 hours in the following solution: cream of tartar 12 oz., chloride of tin ½ oz., water 1 gallon. The work is placed in iron baskets and separated with thin perforated sheets of pure tin.

The caustic soda method consists of preparing the work the same way and immersing in the following solution: tin chloride 4 oz., caustic soda 12 oz., sodium chloride 1 oz., water 1 gallon. This solution works faster than the cream of tartar, ½ to 1 hour being the time usually required.

Small iron articles may be coated with tin in the following solution: tin chloride ⅓ oz., aluminum sulphate ¼ oz., cream of tartar 1/100 oz., water 1 gallon. Dissolve the required amount of the salts in a small quantity of hot water and add hot water up to required volume, using an iron tank. A few drops of sulphuric acid are then added (about 1 drop per gallon) and the work is left in this solution for ½ to 1 hour. The work should be clean and bright and placed in iron baskets and separated with perforated zinc sheets. —O. J. S., Problem 3,901.

Patents

A Review of Current Patents of Interest

Printed copies of patents can be obtained for 10 cents each from the Commissioner of Patents, Washington, D. C.

1,717,469. June 18, 1929. **Bearing Metal and Method of Making Same.** Robert Jay Shoemaker, Chicago, Ill., assignor to S. & T. Metal Company, Chicago, Ill.

Method of making a lead-sodium alloy which comprises introducing an anti-drossing metal into the molten lead heated to a point to melt said anti-drossing metal, allowing the melt to cool, and introducing sodium into the same while at a temperature between the melting point of sodium and its vaporizing point.

1,717,482. June 18, 1929. **Method of Manufacturing Hollow ware of Silver or the Like.** Louis Weidlich and Martin F. Tracy, Stratford, and Alfred J. Flauder, Fairfield, Conn., assignors to the Weidlich Bros. Mfg. Co., Bridgeport, Conn.

The method of making ornamental sheet metal ware, which consists in placing a flat die plate having an ornamental design of larger extent than the ware to be produced, face down upon a flat metal sheet of stock, also of larger extent than the ware to be produced, passing said superimposed sheets beneath a pressure roller, said sheets being relatively thin and flexible and of the same area, whereby the design of the die is impressed in the stock gradually from end to end, with the entire effect of the pressure being concentrated upon only one line to insure a sharp and uniform design over the entire area of the stock, cutting the stock into blanks of any desired size and shape without respect to the design on said stock, and finally shaping each blank to form an ornamented article.

1,717,643. June 18, 1929. **Die for Permanent Moldings.** Harry M. Williams, Dayton, Ohio, assignor to General Motors Research Corporation, Detroit, Mich., a Corporation of Delaware.

In a permanent mold, a mold section of ferrous metal, heat-dissipating elements bonded integrally therewith and comprising thin radiating sheets of metal of high heat conductivity, adjacent sheets being connected by a layer of the same metal.

1,717,820. June 18, 1929. **Compound for use in Casting Metals.** Benjamin F. Wallace, Brooklyn, N. Y.

A parting composition for models of foundries, comprising a finely divided precipitated alkaline-earth metal carbonate constituting its major ingredient, the same being impregnated with a very small percentage of an organic waterproofing substance, said composition being extremely light and capable of floating on water without settling for long periods and in excess of fourteen days.

1,717,916. June 18, 1929. **Mold and Method of Casting Aluminum.** Donald J. Campbell, Muskegon, Mich.

A mold comprising a drag having a piston skirt embedded therein, the upper end of the skirt extending above the upper side of the drag, a core within the skirt, the upper end thereof being of less diameter than the inner diameter of the upper end of the skirt and extending above the upper end of the said skirt, a cope located over the drag having a recess for the head of the piston located over and around the upper ends of said skirt and core, said cope being formed at its under side with a circular groove around said recess therein and with a plurality of spaced apart gates extending from said groove connecting said groove with said recess.

1,718,419. June 25, 1929. **Bronzing Machine.** William Hollingsworth, Baltimore, Md.

The combination with a housing, sheet conveying means therein, and movably supported rubbing means for contact with the sheets being conveyed within the housing, of a container, means for delivering material from the container onto the sheet, means for delivering an air blast across the outlet of said material delivering means between said outlet and a sheet being conveyed for scattering material over the sheet and means for deflecting the scattered material toward the rubbing means.

1,718,502. June 25, 1929. **Copper-Aluminum Alloy.** Eugen Vaders, Heddernheim, near Frankfort-on-the-Main, Germany.

Copper-aluminum alloys containing 5-9.5 per cent aluminum manganese within the limits of 1 to 6 per cent and tin within the limits of 0.01 to 2 per cent.

1,718,563. June 25, 1929. **Treatment of Metals.** Floyd C. Kelley, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York.

The method of providing iron with a surface alloy which is resistant to oxidation at high temperatures, which consists in heating the iron in hydrogen in contact with powdered chromium and silicon at a temperature of approximately 1350° C.

1,718,642. June 25, 1929. **Light-Metal Alloy.** John A. Gann, Midland, Mich., assignor to The Dow Chemical Company, Midland, Mich.

As a new product, an alloy consisting of magnesium, copper aluminum and cadmium, wherein the magnesium largely predominates and the amount of the copper ranges from approximately 3 to 12 per cent, the amount of copper exceeding that of aluminum and the latter as well as the cadmium being present in substantial amounts.

17,347. July 2, 1929. **Process for Melting and Refining of Non-ferrous Metals.** Daniel Cushing, Cambridge, Mass., assignor to The Barrett Company, a Corporation of New Jersey.

The process which comprises melting a non-ferrous metal by burning pitch coke which is substantially free from ash and materials that would have a deleterious effect upon said metal in direct contact with said metal.

1,719,056. July 2, 1929. **Recovery of Zinc.** William Grenville Horsch, Coraopolis, Pa., assignor to Vulcan Detinning Company, Sewaren, N. J., a Corporation of New Jersey. Filed Dec. 2, 1926. Serial No. 152,305. 10 Claims. (Cl. 23—147.)

1. The process of recovering zinc from materials containing zinc and iron which comprises subjecting the material to the action of a solvent that dissolves zinc but not iron to form a metastable solution as the zinc concentration increases, and recovering a zinc-bearing product from the resulting solution.

1,719,167. July 2, 1929. **Cleaning of Metals, Etc.** George D. Chamberlain, Ashland, Ky., assignor to R. T. Vanderbilt Company, Incorporated, New York, N. Y.

A non-oxidizing mineral acid bath for pickling or cleaning metals which contains a small amount of a condensation product of a nitrogenous base with a ketone.

1,719,168. July 2, 1929. **Pickling of Metals, Etc.** George D. Chamberlain, Ashland, Ky., assignor to R. T. Vanderbilt Company, Incorporated, New York, N. Y.

A non-oxidizing mineral acid bath for cleaning or pickling metals which contains a small amount of hexamethylenetetramine as an inhibitor.

1,719,276. July 2, 1929. **High-Temperature Casting Investment.** Charles A. Overmire, San Francisco, Calif., assignor to The Western Gold & Platinum Works, San Francisco, Calif.

A mixture for forming investments suitable for the casting of high melting point metals and alloys composed of at least 50 per cent magnesium oxide and the remainder calcium sulphate.

1,719,365. July 2, 1929. **Tarnish-Resisting Silver and Silver Plate and Processes for Producing the Same.** Daniel Gray and Richard O. Bailey, Oneida, and William S. Murray, Utica, N. Y., assignors to Oneida Community, Limited, Oneida, N. Y.

The herein-described process of producing tarnish-resisting silver, silver alloy or silver plate which consists in exposing the silver, silver alloy or silver plate to mercury in an oven maintained at a suitable temperature for the vaporization of the mercury and the absorption thereof by the silver, silver alloy or silver plate.

Equipment

New and Useful Devices, Machinery and Supplies of Interest

Pyrometers for Non-Ferrous Metals

An engineering survey has been made by the A. C. Nielsen Company, Chicago, Ill., of the use of pyrometers manufactured by the Thwing Instrument Company, 3339 Lancaster Avenue, Philadelphia, Pa. The Nielsen engineers studied the use of two Thwing pyrometers at the plant of the Ellison Bronze Company, Jamestown, N. Y., manufacturers of casement hardware, ornamental bronze, tablets, etc. The survey, according to the Nielsen company, showed that definite operating economies were effected by the precision methods entailing the use of the Thwing pyrometers. The Ellison company has used Thwing pyrometers for twelve years, it is stated, checking from 25 to 40 pots of metal daily, with from 2 to 12 readings obtained per junction. The use of the instruments permitted pouring within 25 degrees of the desired temperature. The first instrument was operated for twelve years with only one repair. Both pyrometers are calibrated monthly. It was found that the annual operating cost is $37.85 per instrument and the daily cost $0.13 per instrument. Closer

Complete Thwing Pyrometer

control of temperature is stated to have effected a 5% decrease in rejections and since rejected parts cause an average loss of 20 cents per pound, the company has saved $19.74 a day while using the pyrometers, an annual gain of $5,922.

The method of testing temperatures at the Ellison foundry is described by the Nielsen company as follows:

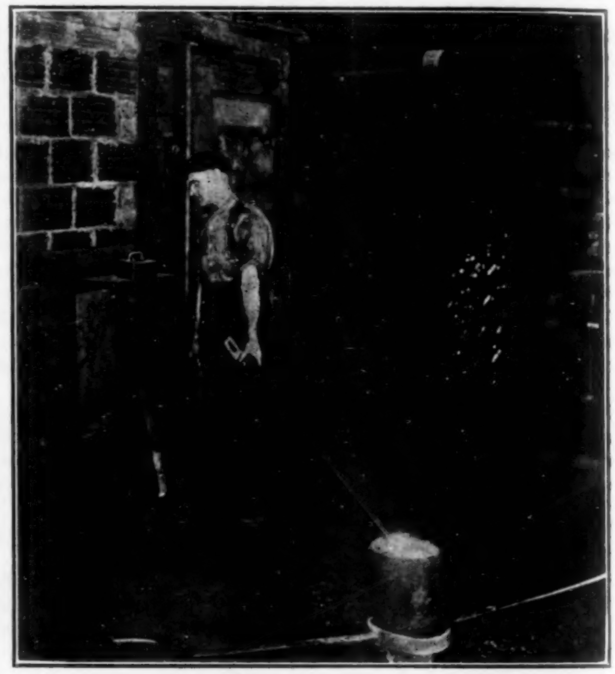
The products of the foundry call for both deep mold and shallow relief work and castings range in weight from a few ounces to several hundred pounds in the case of bank fittings, large plaques or ornamental pieces. The foundry operates 10 hours a day for 300 days a year. Metal is melted in 3 reverberatory furnaces. From 5 to 7 heats per furnace are poured daily and the total output averages 2,000 lb. of castings. Fuel oil is used. Metal to be cast is taken from the furnaces in 100-lb. pots, and each pot is tested for pouring temperature as it is carried to the foundry floor about 50 feet away.

The two pyrometers are mounted on a small waist-high shelf on the passageway from furnace to floor. Although sturdily constructed they are protected by a cover when not in use. The arms containing the thermo-couple wires are also in a box on the shelf and can be quickly removed when needed, thus protecting the instruments from careless handling.

Readings are taken immediately after fluxing by one of the men carrying the pot or by the foundry foreman. The charcoal on the surface minimizes adherence to the junctions so that with brass or bronze two or three readings are taken with one junction and with aluminum ten to twelve readings. Two junctions can be made before pulling additional wire from the spools.

The maximum time required to take a reading (setting the crucible down, immersing the elements, reading the instrument, skimming, etc.) is 30 seconds, although the elements are actually immersed only 7 or 8 seconds in brass and slightly longer in aluminum. Use of two instruments permits testing two metals being poured, without having to change junctions. Aluminum is poured at about 1,300° F., yellow brass and phosphor-bronze at 2100° and commercial bronze at 2150°. If a pot is too hot it is stirred to hasten cooling and if too cold it is returned to the furnace.

Testing pot instead of furnace temperatures permits more accurate control because of the brief lapse of time before pouring and with this method it is possible to pour a pot within 25° of the desired temperature.



Taking Temperature of a Pot of Metal Before Pouring

During several years of operation this foundry has experimented from time to time with allowing either the foreman or a laborer to judge temperatures by eye and to pour when the color appeared right. In each case such practice resulted in improper pouring temperatures, and rejections of castings increased from the normal 2% or less to as high as 10% because of frequent mis-runs due to cold metal, or to porous castings resulting from too high a pouring temperature. The latter is particularly expensive since often the defects are not discovered until considerable finishing work has been done on the parts. The metal is recovered but the cost of the finishing operations up to the point of rejection represents a loss.

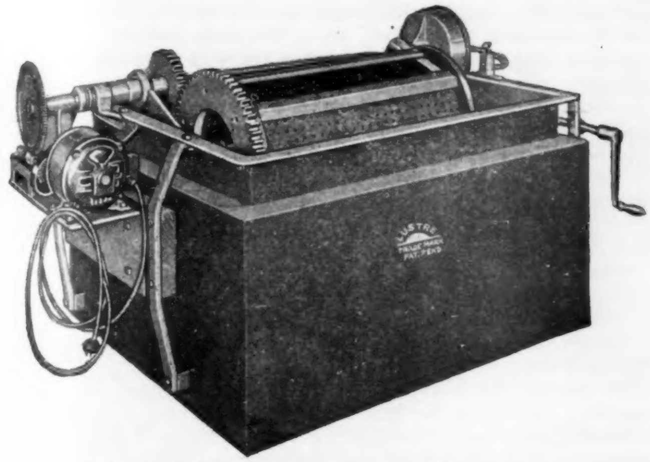
Green Thread Buffs

E. Reed Burns Manufacturing Corporation, 21 Jackson Street, Brooklyn, N. Y., manufacturers of buffing and polishing materials, has obtained trade mark registration at the United States Patent Office on its official mark for "Green Thread Buffs." This trade mark has been used on labels and other markings for the company's buff wheels in Class 4, abrasive, detergent and polishing materials, continuously since October, 1928.

Improved Cylinder Plater

A new type of cylinder plating equipment has been placed on the market by The Lustre Company, Inc., 3307 North Broadway, St. Louis, Mo., manufacturers of supplies and equipment for electroplaters, polishers, etc. The new apparatus is shown in the illustration, with the cylinder in unloading position.

The machine is stated to have a number of features and marked advantage, including the elimination of chains, cables,



Jacketed Cylinder Plater in Unloading Position

belts, and overhead obstructions; no mechanical gears in solution; all-formica cylinder of very rigid construction; gears always meshed; simple, easy lifting of cylinder regardless of load; automatic clutch permitting free swinging of cylinder in either direction for loading and unloading; jacketed tank to regulate temperature of solution.

It is pointed out by the manufacturer that the jacket feature makes it possible to eliminate all delays due to improper solution temperature. The apparatus can be used for copper, brass, cadmium, nickel or zinc plating. It can be furnished with wooden tank if desired, and extra heavy welded tanks are made for hot or cold cyanide solutions.

Pocket-Size Pyrometer

A small, optical pyrometer for use of founders, metallurgists, refiners, smelters, etc., has been placed on the market by The Maco Template and Engineering Company, Ltd., 19 Cursitor Street, London, E. C. 4, England. The instrument is known as the "Pyroversum" and can be carried in the pocket. It registers temperatures from 550° to 1200° Centigrade, has a scale 5½ in. long, calibrated for every 10 degrees. It weighs one-half pound. The makers state that the instrument has received the highest recommendations from European users, including the British Government, the British Royal Mint, the London metropolitan water board and many firms. Its special features are listed by the Maco company as follows:

Prepared for instant use; no adjustments needed; no waiting for measurements; records from any distance; no skill necessary for operation; low initial cost and no renewals needed; accessories and dipping solutions eliminated; readings accurate; size and shape to suit pocket; uninfluenced by atmospheric changes.

Flexible Copper Water Tubing

The Chase Companies, Inc., announce the introduction of 99 per cent copper flexible water tubing, a new departure in plumbing material. It is claimed for it that its installation is cheaper and easier than replacement by standard brass or iron piping. Being flexible, it can easily be curved around most corners without elbows or couplings. In some cases 60-foot lengths may be used in continuous pieces. It is stated that the new type of tubing will stand up under 3,000 pounds pressure. All necessary fittings for connecting the lengths with standard faucets, hot water tanks and standard water pipe are also being manufactured by the Chase concern. The company is also making copper straps for fastening down the tubing. The tubing and fittings are made in sizes from ⅜ to 2 inch.

The only tool in addition to ordinary plumbing tools required to handle the pipe is a special flanging tool which is also supplied by the company. Rodney Chase, vice-president of the Chase Companies, is understood to be largely responsible for the development and introduction of the pipe. —W. R. B.

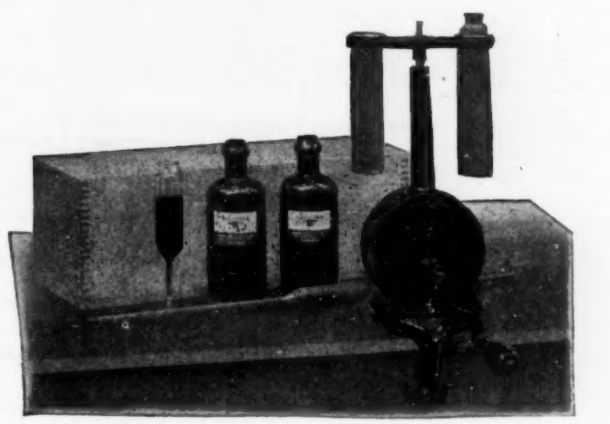
Thermo-Element Reclaiming Service

Charles Englehard, Inc., Chestnut street, Newark, N. J., offer a service of reclaiming used thermo-elements made of rare metals and alloys. The company states that upon examination under the microscope, used thermo-elements show a crystalline structure as well as discoloration. These changes, they state, can be reversed by a special reclaiming process and the thermo-element restored to operating condition. While a couple cannot always be restored to its original condition, they state, it can be sufficiently improved to make the service profitable to users of thermo-elements.

Sulphate Test Set for Chromium

The State Manufacturing Company, 4724 South Turner avenue, Chicago, Ill., has placed on the market the "Kocour" sulphate test set for chromium plating solutions. The apparatus, as shown in the illustration, is sold together with the necessary chemicals for rapid and accurate testing, according to the makers, who give the following data in regard to its operation:

Using the small pipette, 5 ml of solution "A" is introduced into one of the centrifuge tubes. Using the large pipette 20 ml of the



Sulphate Test Set

solution to be tested is added to it and the mixture shaken. Now 5 ml of solution "B" is added and the tube corked and shaken vigorously for one minute and then allowed to stand for 5 minutes. It is now placed in the centrifuge and centrifuged until the volume of the precipitate formed in the stem of the tube becomes constant. Usually this takes less than one minute. The stem of the tube is graduated so that each division represents .02 (two hundredths) of an ounce (avoirdupois) per gallon of sulphate. Major divisions on the stem each represent .1 ounce per gallon.

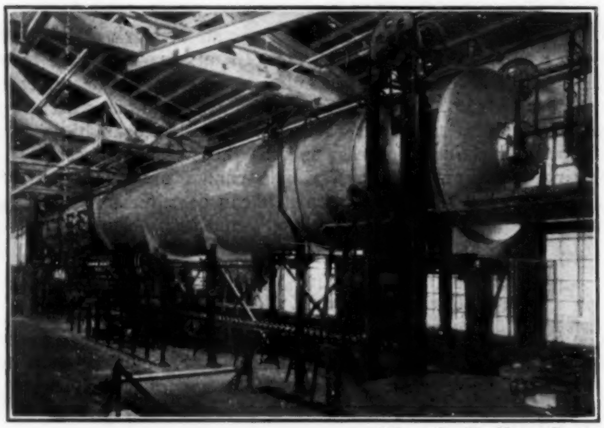
All tests that we have made with this apparatus check with the chemical methods to the nearest .02 oz./gal. and in most cases to the .01 oz./gal. These tests were made on a great variety of solutions and in no case was a discrepancy found, the makers claim.

The set includes: A well made centrifuge with head and shields, two calibrated centrifuge tubes, one 8 oz. bottle each of solutions "A" and "B," pipettes, and a card of directions. The only upkeep is the cost of replenishing solutions "A" and "B." Analyses of these solutions are given in a direction card for those wishing to make their own. Forty tests can be made with the two bottles of solution. The direction card gives the detailed procedure to follow as well as methods of determining the amount of sulphate necessary to add when such is needed. The entire outfit is packed in a slide top, lock corner box which can be screwed to a wall and used as a cabinet for the solutions and tubes.

Brazing in Furnace Using Hydrogen Atmosphere

A new brazing furnace, placed on the market by the General Electric Company, Schenectady, N. Y., utilizes a gaseous atmosphere and is automatic in operation. The only labor involved in its operation is that necessary to keep the furnace supplied with work.

Perfection of the method of hydrogen brazing, announced by the General Electric Company early in 1928, followed many years of development and research. This method brazes the parts together by means of a copper flux. While not new, it had previously been attended by a number of practical difficulties in application.



Photo, G. E. News Bureau

Continuous Hydrogen Brazing Furnace

The new General Electric furnace is of the tunnel type of construction. The furnace proper rests on supports above a roller conveyor. On this conveyor rests a row of trays on which the work is loaded. The furnace itself has openings at either end, in the bottom. The furnace is heated at the entrance end and cooled at the other. Motor-operated elevators, located beneath the furnace openings, raise the trays of work into or lower them from the furnace.

In operation, the trays are loaded on the roller conveyor which is completely covered with trays from end to end. The elevators, at the beginning of the cycle, are in the lower position. A motor-operated ram at one end then pushes the tray from the discharge elevator upon the conveyor, thus moving all the trays along and pushing one tray upon the intake elevator. The elevators then ascend automatically until the loaded elevator brings its work into the heated end of the furnace, while the empty elevator is ready to receive a tray of brazed work at the discharge end. Another motor-operated ram pushes the intake tray into the furnace and thus pushes out a tray of completed work upon the elevator at the other end. The furnace is equipped with a conveyor system similar to the one below it. The elevators now drop to the lower position once more and the cycle is repeated.

The heating units located at the entrance end of the furnace are arranged in several zones, the temperature of which is automatically controlled.

In loading the work on the trays, it is arranged on vertical supports. When in the heated end of the furnace the tray itself is carried in a lower chamber, the vertical supports projecting up through a slot and thus keeping the work in the heated portion of the furnace, while the tray is protected. As a further protection to the tray, it is covered with heat insulating material.

In preparing the work for brazing, the parts are either wound with copper wire or coated with copper paint. The effect of the gaseous atmosphere (a mixture of hydrogen and nitrogen) is that of a flux, cleaning the work and causing a very smooth flow of the liquid copper over the surface to be brazed, and into the joints.

Chain Hoist

The Handy Hoist Company, 847 West 120th Street, Chicago, Ill., has placed on the market a low-head-room electric hoist under the trade name of "Handy Andy". The "Handy Andy" is stated to be a simple, compact hoist having a total weight of 160 pounds, 24" in length and 7½" in diameter, with lifting capacities of 500, 1,000 and 1,500 pounds. It is a fully enclosed unit, all working mechanism being encased in a heavy cast housing; from which the entire gear mechanism, as well as the drum-type switch, may be easily taken out by removing the end plate. The motor can be removed without disturbing the wiring.

The hoist is equipped with 110 volt, universal A. C. or D. C. motor, with cord and plug for operation from any lamp socket. Standard equipment also includes 12 feet of load chain with hook at one end, and it has positive mechanical load control—brake engaging at the same time switch is thrown into neutral, thereby preventing either coasting or slipping of the load.

Low-Head-Room Hoist

Cotton Buff Wheels

The Williamsville Buff Manufacturing Company, Danielson, Conn., has been manufacturing a line of cotton buff wheels since 1893. According to Fred W. Worch, vice-president and general manager of the company, the original product of the company was the A-1 buff wheel, which the company still manufactures. This an 80x92 count, 3.25 weight and is made of Quinebaug sheeting. According to Mr. Worch, this was the first high-count buff to be universally adopted by the polishing trade. With changing industrial conditions the company has added to its line a 3.15 weight buff and also a 2.90 weight in 84x92 count, also made of Quinebaug sheeting and said to be of very high grade.

The company's business has steadily increased through the years, with the last two showing an especial gain in sales of the high quality wheels manufactured under the Williamsville trade mark, Mr. Worch states.

Chromium Plated Sheets

Chromium plated sheet metal for advertising and other uses is being offered by Apollo Metalarts, La Salle, Ill. The company manufactures the sheets in various thicknesses, with one side chromium plated.

The makers state the sheets have been adopted for window displays and other purposes by all types of stores and other businesses requiring brilliant, attention-compelling displays.

Its ultra-modernity is stressed, as well as its adaptability to a great variety of uses. The company markets the material under the name "Chromflex." Copper, nickel and brass plated sheets are also available under the designations "Copperflex," "Nickelflex," and "Brassflex." These are also being used widely for display and advertising, according to the makers.

Equipment and Supply Catalogs

Ford **Charcoal Briquets.** Ford Motor Company, Dearborn, Mich. Booklet on foundry fuel.

Laclede-**Christy Clay Products Company,** St. Louis, Mo. Leaflet on fire brick and refractories; illustrated.

Building a Better Box Header Boiler. Combustion Engineering Corporation, New York City. Leaflet, illustrated.

Executives **Service Bulletin No. 9.** Policyholders Service Bureau, Metropolitan Life Insurance Company, New York City.

The **Denham Costfinder for General Managers.** The Denham Costfinding Company, 3030 Euclid Avenue, Cleveland, Ohio.

The **Life of Your Roof Hangs by a Nail.** Copper and Brass Research Association, 25 Broadway, New York City. Leaflet on copper nails.

Stop the Crowds with Chromflex. Apollo Metalarts, La Salle, Ill. Handsome brochure on chromium plated sheets for display and other purposes.

Wagner Squirrel-Cage Motors. Wagner Electric Corporation, St. Louis, Mo. Discussion of 7 types of squirrel-cage motors in 24-page illustrated booklet.

Factors **Affecting Grinding Wheel Selection.** Norton Company, Worcester, Mass. A well printed booklet providing data of importance to users of abrasives.

Bristol's Recording Psychrometers. The Bristol Company, Waterbury, Conn. Catalog No. 2100; mechanisms for recording and controlling relative humidity. Well illustrated.

Workmen's Safety Committees. Metropolitan Life Insurance Company, New York. Methods of organizing and conducting safety committees. This is No. 5 of the "Industrial Safety" series.

Gehnrich Foundry Ovens. Gehnrich Oven Company, Inc., Long Island City, N. Y. Ovens for baking, mold drying, pasting, blacking, preheating, aging, normalizing, etc.; 16 pages, illustrated.

Type-T Weldite Rods. Fusion Welding Corporation, 103rd Street, Chicago, Ill. A new alloy welding rod for applying wear-resistant surfaces from gas or electric welding. Illustrated pamphlet.

Nichrome—The Heat Resisting Alloy. Driver-Harris Company, Harrison, N. J. Fine illustrated book showing various applications of Nichrome alloy, especially in foundries and metal working plants.

Duriron Exhaust Fans. The Duriron Company, Inc., Dayton, Ohio. Bulletin No. 158, 12 pages, illustrated, covers exhausters for fumes from corrosive and other liquids, hoods, fume ducts and ventilators. Also, **Duriron Split Flanged Pipe.**

Electricity for Industrial Heating. Commonwealth Edison Company, Chicago, Ill. Handsome illustrated brochure filled with illustrations showing many uses of electric heat in industry, such as melting and heat treating of metals, core baking, etc.

Rare Metals. Fansteel Products Company, Inc., North Chicago, Ill. The history, properties and uses of tantalum, tungsten and molybdenum; a 54-page, illustrated book containing interesting and valuable information; free on request to the company.

Columbia Electroplating Generators. The Columbia Electric Manufacturing Company, 1292 East 53rd Street, Cleveland, Ohio. A 16-page illustrated catalog of generators for various types of plating plants. Construction details and other engineering data are given.

Chase Copper Water Tubing. Chase Brass and Copper Company, Inc., Waterbury, Conn. Catalog of water tubing and compression fittings for easy replacement; trade edition; 48 pages, profusely illustrated. Explains the use of the product, with complete directions for installation.

The Homo Method for Production Tempering. Leeds and Northrup Company, Philadelphia, Pa. Catalog No. 93, 32 pages, illustrated. This company also has just issued **Optical Pyrometers,** catalog No. 86, 28 pages, illustrated; and **Potentiometer Pyrometers,** catalog No. 87, 44 pages, illustrated.

Reliance Plating and Polishing Equipment. Charles F. L'Hommedieu and Sons Company, 4521 Ogden Avenue, Chicago, Ill. Bulletin No. 105, a 95-page illustrated catalog showing a complete line of generators, mechanical plating apparatus, polishing machinery, supplies for platers and polishers, etc. A handsome catalog which should be kept handy by all platers, polishers and finishers. The book is handsome and well bound.

General Electric Company, Schenectady, N. Y., publications: **Electric Furnaces,** 20-page illustrated booklet showing various industrial applications; **Electric Heat in Industry,** a 48-page bulletin which illustrates application of electric heat to groups of basic operations commonly found in industrial plants; **Motor Drives for Rolling Mills,** partial list of main roll motors, 64 pages, illustrated; **Textolite Laminated,** leaflet on a product made of paper, cloth and resin, with great endurance properties; **Other Leaflets:** Enclosed Magnetic Switches; Strip Heaters; Synchronous Motors for Pumping; Heating Equipment for Electrotype Metal; Cartridge-Type Electric Heating Units.

Associations and Societies

REPORTS OF THE CURRENT PROCEEDINGS OF THE VARIOUS ORGANIZATIONS

American Foundrymen's Association

HEADQUARTERS, 222 WEST ADAMS STREET, CHICAGO, ILLINOIS

Convention at Cleveland—1930

The American Foundrymen's Association will hold its annual convention and exhibit of foundry equipment and products at Cleveland, Ohio, from May 12 to 16, 1930. The convention will take place in the Cleveland Public Auditorium and its Annex, which will offer unlimited facilities for exhibition and for the various sessions to be held.

The early announcement at hand now states that there will be a good program of papers and sessions for all branches of the foundry industry. In the non-ferrous field there is expected to be an especially good group of papers and addresses.

Complete data will be published in these columns as soon as available so that readers of THE METAL INDUSTRY will be well posted in advance on all details of the preparations for the convention.

AMERICAN ELECTROPLATERS' SOCIETY

Los Angeles Branch (Temporary)

HEADQUARTERS, CARE OF M. D. RYNKOFS, 1354 WEST 25TH STREET, LOS ANGELES, CALIFORNIA

The regular September meeting of the temporary Los Angeles Branch of the American Electroplaters' Society was held the

second Wednesday of the month at the Central Y. M. C. A., Los Angeles, at 6:30 p. m. Thirty-seven sat down to dinner.

Joseph Corbit, with a few well chosen remarks, installed C. E. Thornton as president, who in turn installed the other officers.

We had two visitors, E. W. Heil, Wichita, Kan., and James Emmett, San Diego, Calif. Ed Heil gave us an interesting account of the convention, and read the main items of papers given at the recent convention. Jim Emmett complimented the new Branch on the enthusiasm shown and wished it success.

J. Ellis took charge of the educational program. Some interesting discussion took place.

—M. D. Rynkofs.

Rochester Branch

HEADQUARTERS, CARE OF CHARLES GRIFFIN, 24 CARSON AVENUE, ROCHESTER, NEW YORK

The Rochester Branch of the American Electroplaters' Society held its annual family outing and clam bake at the Old Homestead on Irondequoit Bay, N. Y., Saturday, September 28. There were sports for all, a good shore dinner, and dancing. The arrangements were made by a committee composed of Clarence Reama, Gerald A. Lux, Clarence O. Fields, Frank Mesek and Charles Griffin.

The September meeting was held on the evening of the 27th.

—Charles Griffin.

Personals

Edward Browning Sanigar

Dr. Edward Browning Sanigar of Sheffield, England, has been awarded the first Weston Fellowship by the American Electrochemical Society. The award was recommended by the Weston Fellowship Committee, of which Prof. Lincoln T. Work is chairman, and was formally accepted by the Board of Directors of the Society. Under the Fellowship, Dr. Sanigar will come to the United States for a year's research work at Columbia University, where he will devote his attention to the electrodeposition of chromium, in which he has been interested for some time, doing research work in this field in England.

Edward Browning Sanigar

Dr. Sanigar is a graduate of the University of Sheffield, where he earned the degree of Master of Science, and Charles' University, Prague, Czechoslovakia, where he took the degree of Doctor of Science. He is an Associate of the Institute of Chemistry of Great Britain and Ireland. In 1924-1925 he was the first holder of the scholarship for travel abroad granted by the Worshipful Company of Cutlers, London, England. Since 1926 he has been Investigator in Electrodeposition for the British Government Electrodeposition Committee and the British Non-Ferrous Metals Research Association. He has also acted as part-time Demonstrator in Physical Chemistry and as Lecturer in Electro-Metallurgy at the University of Sheffield. His publications cover a wide field of electro-chemistry, with particular reference to the electrodeposition of silver from cyanide solutions. As stated above, Dr. Sanigar is now interested in chromium deposition and will continue his studies in this field.

Alfred K. Pritchard, Jr., of 50 Ninth Avenue, Newark, N. J., has accepted a position as foreman plater with the Rumidor Corporation, Weehawken, N. J.

Andrew V. Re has accepted the position of engineering supervisor in the electroplating and polishing department of the Wahl Manufacturing Company, Chicago, Ill.

H. W. Pearsall has been made vice-president and a member of the firm of Finishing Research Laboratories, Inc., Chicago, Ill. Mr. Pearsall, one of the engineering staff, has had wide experience in research on various finishing and processing methods for paint, lacquer and electroplate application.

William Tyler Ball has take a position as sales engineer with the Burgess-Parr Company, Moline, Ill. He was formerly connected with the Deere Spreader Works, Moline, and will specialize in foundry products such as non-ferrous and special alloy castings.

Otto Abrahamsen is now affiliated with the Moloch Foundry and Machine Company, Kaukauna, Wis., for whom he will take charge of sales of power hammers. He was formerly for twenty years treasurer and sales head for the Beaudry Company, Boston, Mass., also machinery makers, now in liquidation. His headquarters will be at Kaukauna.

Mark Weisberg, formerly president of the Textile Chemical Company, Inc., and treasurer of the Modern Plating Company, Providence, R. I., is now president of the Chromium Engineering Corporation, 132 West 42nd Street, New York City. Mr. Weisberg is a member of the American Electrochemical Society, the American Chemical Society and the American Association for the Advancement of Science.

J. S. Gillard has been placed in charge of sales of McKeon's "Liquid Sulphur" by the Sulphur Products Company, Greensburg, Pa. He also has charge of sales of "Natrolin" metal cleaner for W. A. Fuller Company, also of Greensburg, according to an announcement by Wilfred S. McKeon, president of the Sulphur Products Company.

Paul D. Merica has been appointed technical assistant to the president of the International Nickel Company, New York. He was previously assistant manager of the company's development and research department.

Norman Cudworth Cohn, chemical engineer, has joined the staff of the Roxalin Flexible Lacquer Company, Inc., Long Island City, N. Y. Mr. Cohn, a graduate of Columbia University, where he has gained considerable fame as a swordsman, going so far as to represent the United States in the 1928 Olympic Games, is an expert chemist and will be a member of the Roxalin Company's technical department.

Frank Carter, formerly inspector of metallurgical work for the United States Government, metallurgist for the Nordyke-Marmon Company and for the General Motors Corporation, has been placed in charge of the metallurgical department of James H. Knapp Company, Los Angeles, California.

Obituaries

Charles Renneberg

Charles Renneberg, for the past six years metallurgical expert for the J. B. Wise Company, Watertown, N. Y., was killed during the latter part of September in an automobile accident near Watertown. Mr. Renneberg was widely known as an expert in metals. For twenty years previous to his connection with the Wise company he was superintendent of the former McNab and Harlin Manufacturing Company, Paterson, N. J.

Harry Allison Higgins

Harry Allison Higgins, 54 years old, vice-president of the Higgins Brass Co., Detroit, died recently at Colchester, Ont., his summer home. The funeral and burial were in Detroit. He had been a resident of Detroit for the last 20 years.

—F. J. H.

H. Cole Estep

H. Cole Estep, vice-president of the Penton Publishing Company, Cleveland, Ohio, a prominent figure in the American Foundrymen's Association for many years, died suddenly of heart disease on September 30, 1929. He was 43 years old.

George W. Gilbert

George W. Gilbert, vice-president of the A. Gilbert and Sons Brass Foundry Company, St. Louis, Mo., died there a short time ago, aged 58 years, after more than forty years with the company which was founded by his father, A. Gilbert.

News of the Industry

Industrial and Financial Events

Course in Electroplating at City College

The course in practical electroplating at the College of the City of New York commences its second year on the evening of September 30th, under the personal direction of Dr. L. C. Pan. It is open to all persons interested in electroplating, metal finishing and chemical control of plating solutions. The class will meet on Mondays and Wednesdays from 7 p. m. to 11 p. m. in the Chemistry Building, Amsterdam Avenue at 138th Street, New York City.

The subject matter of the course will deal with the following topics:

1. Fundamental principles underlying the various operations of electroplating.
2. A critical study of each of the present processes and commercial practices of electrodeposition of various metals and alloys, including copper, nickel, chromium, silver, gold, cadmium, zinc, brass, iron, lead, tin and platinum.

Laboratory work constitutes an important part of the course. The exercises are mostly of deductive nature, thus bringing the student to a first-hand knowledge of the principles involved. Among the exercises to be done in the laboratory are the Faraday's law, current efficiency, determination of thickness of deposit, electrode potentials, polarization and depolarizers, metal and metal-ion concentration, addition agents, brighteners, throwing power, porosity and corrosion tests, analysis of plating solutions. Registration for the fall term is now open.

Ajax Metal Company Expands

The Ajax Metal Company, Philadelphia, Pa., manufacturer of Ajax-Wyatt electric melting furnaces, has just completed construction of an entirely new plant for production of these furnaces. Expansion was made necessary by the rapidly increasing demand for the equipment, the company states. In the new plant, located at Frankford Avenue near Girard Avenue, ample provision has been made for experimental work, modern storage and handling facilities for service and parts, lining materials, etc.

List of Alloys Out of Print

The American Society for Testing Materials, Philadelphia, Pa., publishers of "A List of Alloys," well known and widely used pamphlet, advise that the list is now out of print and is undergoing revision upon completion of which a new edition will be printed. According to J. K. Rittenhouse, assistant treasurer, it will be at least a year before the new edition is ready.

Hammond Machinery Builders, Inc.

In order to make the name of the firm more representative of its business and ownership, the Hill-Curtis Company, Kalamazoo, Mich., has changed its official designation to Hammond Machinery Builders, Inc. The company, which manufactures a well known line of power saws, polishing and grinding machinery, will continue to operate as previously, under the supervision of W. C. Hammond, president, who states that the new name is more appropriate since there are neither Hills nor Curtises connected with the firm now.

Autos and Utensils Use Most Aluminum

The automobile industry is the largest consumer of aluminum and the cooking utensil industry is second, according to a chapter on aluminum by C. L. Mantell in "Mineral Industry, 1928." Mr. Mantell states that the use of aluminum for motor pistons showed a large gain during the year, with the production of such pistons during the year estimated at 20,000,000 pounds. There was also a large quantity required for engine castings, forgings, connecting rods, crank cases, etc.

Household appliances, with utensils uppermost and such articles as vacuum cleaners, washing machines, etc., being made extensively of aluminum, consumed the second largest amount. Third was the electrical consumption, with aluminum going into conductors, including steel-reinforced, high-tension transmission-line cable as well as all-aluminum cable and bus bars. The jobbing foundries, producing a great variety of castings for thousands of different products, was the fourth largest consumer. The use of granulated aluminum ingot, grained ingot, notch bar aluminum and rod made the steel industry the fifth largest consumer in 1928.

Brass and Bronze Ingots

On September 1, 1929, unfilled orders for brass and bronze ingots and billets on the books of the members of the Non-Ferrous Ingot Metal Institute, Chicago, Ill., amounted to a total of 15,065 net tons.

The combined deliveries of brass and bronze ingots and billets by the members for the month of August, 1929, amounted to a total of 7,864 tons.

Equipment Exhibit at Bridgeport

Practically all the plating and polishing supply companies distributing their products in New England will exhibit at the Co-operative Exhibition of the Salesmen's and Purchasing Agents' Association of America, to be held at Pyramid Mosque, Bridgeport, Conn., October 17 to 19, inclusive, 1929. Other features will be small tools, direct and indirect materials and general factory supplies.

Doehler Die Casting Company

Doehler Die Casting Company, New York, reports operating profits for the month of July, 1929, were $83,287 as against $34,358 in the same 1928 month, a gain of 143%. Net operating profits for the first seven months this year were $644,524 against $465,165 for the 1928 period.

Radio World's Fair

The sixth annual Radio World's Fair was held at Madison Square Garden, New York City, September 23-28, 1929. There were a considerable number of displays of radio apparatus of all kinds, with receiving sets for home use, of course, in greatest evidence. Practically all the major and most of the minor companies engaged in producing radio sets and parts were there, and also a number of concerns making products used by the radio industries but not primarily allied with radio. Among the latter were the Aluminum Company of America, Pittsburgh, Pa.; the Phosphor Bronze Smelting Company, Philadelphia, Pa.; the

Multi-Metal Wire Cloth Company, Inc., New York City; Tubular Rivet and Stud Company, New York City; the National-Harris Wire Company, Newark, N. J.; the Cornish Wire Company, New York City; the Dudlo Manufacturing Company, Fort Wayne, Ind. These companies, respectively, displayed aluminum products; phosphor-bronze and other alloys; pure nickel wire cloth; rivets and rivetting machines; resistance wire; various kinds of wire, lightning arrestors, etc.; coils and other wire products.

Naturally, a great deal of metal was on display in the products of the radio manufacturers. While no novel uses of non-ferrous metals were featured, the exposition was a further proof of the growing consumption of metals and alloys in the radio and other electrical fields.

Anaconda Copper Mining Company

The Anaconda Copper Mining Company, New York, has acquired the Marion Insulated Wire and Rubber Company, Marion, Indiana.

New Companies

Vandtke Pattern and Foundry Company, Inc., 1700 Ohio Avenue, Anderson, Ind.; $25,000 capital; to manufacture metal and wood patterns and brass, bronze and aluminum castings; company is now operating a jobbing foundry at the above address; **H. J. Vandtke,** president.

Business Reports of The Metal Industry Correspondents

New England States

Waterbury, Conn.

October 1, 1929.

In spite of the usual dropping off during the summer, Waterbury's metal industries have been working full time through the past three months, and in practically all of them several departments have been working overtime, some of them day and night. The total number of persons employed in the 46 manufacturing plants employing 100 or more during the month of August was 35,367. The total in the eight largest was 19,339, an increase of 489 compared to the same month last year. Check transactions during August were $50,182,861, an increase of $3,346,000 over the same month last year.

Building additions to factories started during August were: **Chase Companies, Inc.,** 2,800 square feet, valued at $12,000; **American Brass Company,** 560 square feet. valued at $2,000; **Chromium Corporation of America,** 3,501 Square feet, valued at $15,000.

Electric current consumed during the month was 10,815,051 kwh, an increase of 276,090 kwh over the same month last year.

Minority members of the Senate Finance Committee intend to probe the **Scoviil Manufacturing Company's** income tax returns in connection with the proposed new tariff bill. Representatives of the Scovill company, together with representatives of other concerns in this section, have been fighting in Washington for some time to secure a higher tariff on pins and buttons which are now being shipped in from Germany and retailed at prices lower than the local concerns can afford to sell them. Inasmuch as the fight is merely over buttons and pins and the local company produces something over 30,000 articles, it is pointed out locally that inspection of the company's entire tax return will be valueless in determining whether or not it is at present sufficiently protected on these articles. The pins and buttons are made almost exclusively at the plant of the company in Oakville, formerly the **Oakville Company,** which is but a small unit in the company's entire system.

The Waterbury Fastener Company has purchased a small tract of land from the **Chase Companies, Inc.,** adjoining its plant in Waterville. The fastener company's original plant was also purchased from Chase. The new land is required for an addition.

John H. Goss, vice-president and general superintendent of the Scovill Manufacturing Company, was nominated for reelection as vice-president of the **Manufacturers Association of Connecticut** at the annual meeting which will be held in Bridgeport at the plants of the **Remington Arms Company** and the **General Electric Company** this month.

Frederick S. Chase, president of the **Chase Companies, Inc.,** and **Mrs. Chase** returned last month from a two mnths' tour of Europe. They visited Norway, Sweden, Germany, Hungary and Italy.

Local clock manufacturers do not fear any unsatisfactory results will follow the purchase by the Soviet government of two clock companies in this country and their removal to Russia. These plants were the **Ansonia Clock Company** and the **Grueber-Hampden Watch Company.** However, the action is expected to mean stiffer competition in the future.

An increase in the price of brass of about one-quarter of a cent a pound is expected to be made by the local plants during the present month. —W. R. B.

Connecticut Notes

October 1, 1929.

BRIDGEPORT—The Industrial Development Corporation, a New York firm which specializes in new methods of treating copper, is moving here and will take over one of the building units of the **Remington Arms** group in order to be located near the copper-consuming plants of the Naugatuck valley.

Since the merger of the **Raybestos Company** with two similar firms, it has gradually been expanding its plant because of increased business. It has now taken over a portion of the **American Tube and Stamping Company's** plant. The woven brake lining will be made here and its moulded brake lining at its new plant in Stratford.

The Bridgeport Boiler Works has started to erect a one-story steel addition to its plant on Housatonic Avenue. **The Hawie Manufacturing Company,** North Washington Avenue, has started to erect a brick addition, 90 by 50 feet, to its factory on River Street.

The annual meeting of the **Manufacturers Association of Connecticut** will be held here October 8 at the plants of the **Remington Arms Company** and the **General Electric Company.**

TORRINGTON—The directors of the **Torrington Company** have declared the regular quarterly dividend of 75 cents a share, payable October 1 to stock of record September 19.

Members of the sales and mill departments of the Torrington branch of the **American Brass Company** held their annual banquet at the Waterbury Club in Waterbury September 13. **F. L. Brahman** was chairman of the commitee in charge.

BRISTOL—The directors of the **American Silver Company** have declared the regular quarterly dividend of 50 cents a share, payable October 1 to stock of record September 13.

The sales and distribution organization of **Veeder-Root, Inc.,** were the guests of the management September 14. Trips of inspection were made to the plants in this city and Hartford, an outing and golf tournament were held at the Farmington Country Club, and a banquet was held at The Bond Hotel in Hartford.

NEW BRITAIN—Directors of **Landers, Frary and Clark** have declared the regular quarterly dividend of 3 per cent and an extra of 1 per cent, both payable September 30 to stock of record September 20.

F. G. Hausman, factory superintendent of the machinery division of the **Peck, Stow and Wilcox** plant, has been named to the advisory committee of the **State Board of Education** in matters pertaining to foundry training in vocational schools and cooperation in this work between the schools and industrial concerns in this section.

The income tax returns of the **American Hardware Company** will be probed by the minority members of the Senate Finance Committee in an effort to offset arguments made by local concerns for an increase in the tariffs on pins and buttons.

E. W. Christ, vice-president and secretary of the Stanley **Works,** has been nominated a director of the **Manufacturers**

Association of Connecticut, the election to take place at the annual meeting in Bridgeport, October 8.

THOMASTON—**John Waters**, an employee of the **Seth Thomas Clock Company** for nearly 30 years, has been made superintendent of Plant No. 1 of the company.

WINSTED—The local wire shops are running at full time. The **Strand and Sweet Company** is planning an addition which will increase its floor space 50 per cent. **The Winsted Insulated Wire Company** is adding 36 machines to double its output.

The **Union Pin Company** of this city is one of the Connecticut firms whose income tax figures are to be probed by the minority members of the Senate Finance Committee in their fight against the proposed increased tariffs on pins.

STAMFORD—**The Yale and Towne Company** has had plans prepared for a plant addition to cost about $60,000. The contract is expected to be let this month.

WALLINGFORD—**C. D. Morris**, vice-president of **R. Wallace and Sons Manufacturing Company**, has been nominated a director of the **Manufacturers Association of Connecticut**, to be elected at the annual meeting at Bridgeport, October 8.

DERBY—**The Star Pin Company** of this place, the **Sidney Blumenthal Company** of Shelton and the **Risdon Manufacturing Company** of Naugatuck are among the Connecticut firms whose income tax figures will be investigated by the minority members of the Senate Finance Committee in their attempt to prevent the proposed increased tariff on pins and buttons. —W. R. B.

Providence, R. I.

September 28, 1929.

The Gorham Manufacturing Company, the **Nicholson File Company** and the **Brown and Sharpe Manufacturing Company** are each assessed on a corporate excess of more than four million dollars, according to the statement of the State Board of Tax Assessors recently filed with the General Treasurer of Rhode Island for collection. These three corporations, with 37 others, are each assessed on an excess of $100,000 or more each, for a total of $23,022,138, upon which they pay taxes amounting to $83,028.

H. J. Astle and Company, Inc., recently made a shipment of twenty-nine cases of "Boland Systems" to Switzerland. The concern is very busy at present installing "Boland Systems" in various sections of the United States. The domestic demand for the firm's various products which include polishing lathes, sand blasts, burnishing machines, tubbing machines, exhaust fans, electroplating systems, hot blast dryers, etc., is constantly increasing.

Notice has been filed at the office of the Secretary of State that **The Kenney Company**, manufacturers of curtain rods and fixtures, 609 Wellington avenue, Cranston, has increased its capital stock from $150,000 to $250,000.

Information has been filed at the office of the City Clerk that **Siranoush Mesrobian** and **Sarkis Chatalin** are the owners of the **S and M Enameling Company** at 25 Calender street.

The Aetna Lavatories, Inc., and **The Modern Plating Company** at 108 Eddy street have combined under the name of **The Modern Plating Company, Inc.**, and are fitting up a modern plating plant at 45 Hospital Street to which they will remove at an early date. The officers of the new company are as follows: president, **William F. Quarters**; secretary, **Arthur L. Ortman** and treasurer, **Mark Wesiberg**.

Bulletins announcing the need of help in various departments, appearing at entrances of several Providence manufacturing jewelry plants, indicate the results of recent visits of the travelling sales forces to their prospects. **John J. Collins** of the **Ostby and Barton Company**, who has recently returned from an extended trip through the Middle West, reports good inquiry and predicts a season of normal activity.

Several Providence manufacturing jewelry concerns have recently removed their plants to new locations. **S. E. Budlong Company** has removed from 144 Pine Street to 119 Friendship Street. The **Abbott-Beeber Companp** has removed from the second floor to the sixth floor of the **Manufacturers' Building** at 7 Beverly street. **Castanzo and Son** have moved from 158 to 144 Pine street. The **Albert Manufacturing Company** has moved from 45 Richmond Street to 85 Sprague Street and **The Armbrust Chain Company** has leased the fourth floor of the **Irons and Russell Building** at Chestnut and Clifford Streets and is removing thereto as rapidly as it can change its machinery.

George W. Jenckes of Lakewood has been granted a patent on a safety catch for pin stems which he has assigned to the **D. M. Watkins Company** of this city.

The handsome sterling silver trophy awarded by the **Cleveland Pneumatic Tool Company** of Cleveland, Ohio, to the winner of the first ladies' air derby, from Santa Monica, Calif., to Cleveland, was made by the **Gorham Manufacturing Company** of this city. The trophy depicts an aviatrix standing on the globe and holding aloft an airplane. It was carried by airplane from the What Cheer Airport, Pawtucket, to Cleveland where it was awarded.

The contract has been awarded for the erection of a new refinery building at 780 Allens Avenue for **Pease and Curran**, gold refiners at 104 Point Street. It will be one story in height 55 by 100 feet of modern construction and equipment throughout and will cost approximately $30,000.

Beacon Pen Company, Inc., of Providence has been incorporated under the laws of Rhode Island for the purpose of manufacturing fountain pens with an authorized capital consisting of 100 shares of common stock of no par value. The incorporators are **Louis Abedon** of 558 Hope Street, **Louis Dunn** and **Harry Goldshine**.

The Eastern Scientific Company has started in business at 11 Bassett street. where it will conduct a general assaying bureau, and manufacture gold alloys and solders for all purposes, giving especial attention to special solders to suit any gold where easy running effect is necessary, or desired.

Kurtz and Geisler has been incorporated under the laws of Rhode Island and organized under the new charter with **Carl Geisler** as president, **Salvatore Chaippenelli** as treasurer and vice-president and **John H. Kurtz**, secretary, to take over the manufacturing jewelry business conducted under the same firm name as a copartnership. The offices and plant of the firm have been removed from rear of 226 Eddy Street to larger and more commodious quarters at 105 Gordon Avenue.

—W. H. M.

Middle Atlantic States

Newark, N. J.

October 1, 1929.

The **General Cable Corporation**, with executive offices in New York, has purchased the property at Highland Avenue and Hamilton Street formerly owned by the **Herald Manufacturing and Trading Corporation**. The Cable Corporation owns the **A-A Wire Company**, formerly located on Sussex Avenue. The plant was originally built for the **New Jersey Tube Works** and in 1924 the A-A Wire Company, manufacturers of insulated wire, took possession under a long term lease. The premises consist of eight one-story brick buildings with a total floor area of 160,000 square feet.

A large percentage of the 2,300 employes of the **United States Metal Refining Company**, of Carteret, N. J., who were on strike for ten days have returned to work. Their grievances were settled after a conference between **Mayor Mulvihill** and representatives of the plant. The men have been granted every point they demanded with the exception of the 5 cents an hour increase in the wage scale. They will be paid weekly and receive the wage scale in effect before the bonus system was adopted in April, 1928. The bonus system, which has been so objectionable to the men, has been abolished.

Notice has been given to the employes of the metal division, the last remaining unit of the Newark Avenue plant of the **Durant Motor Company**, that production would be discontinued on September 30, and that the plant would be officially closed until October 15, during which the equipment of the metal division will be dismantled and forwarded to the factory of the **City Auto Stamping Company**, Toledo, O., which is to

furnish stampings to the three western plants of the **Durant Motors, Inc.** This will affect approximately 650 workers. It is not known yet what will be done with the Elizabeth plant.

Newark concerns recently incorporated are; **Barr-Knox Corporation,** metal stamping machines, $100,000. **Oakley Valve and Foundry Company,** 5,000 shares common. **American Watch Dial Manufacturing Company,** manufacture watch dials, 250 shares. **George Marks, Inc.,** manufacture jewelry, $100,000. **New Jersey White Metals Company,** 10 shares no par. **Newark Metals Products Company,** $125,000.

—C. A. L.

Trenton, N. J.

October 1, 1929.

To mdernize some parts of the plant of the **John A. Roebling's Sons Compann,** two new buildings are being erected by that concern, one in Trenton and the other at Roebling. The one at Roebling will assemble under one roof machinery now scattered about various parts of the plant. The building is a new copper wire mill, 200 by 500 feet, one story in height. Here will be housed all copper wire drawing machinery. The Roebling company is itself erecting the new addition, which will be completed the latter part of October. The addition to the Trenton plant will be completed shortly.

After a year and a half the U. S. Patent Office has granted a patent to **Edgar Kenneth Freeman,** of Trenton, on his invention of a screw-shell contact for electrical sockets. Freeman assigned his rights in the invention to the **Circle F. Manufacturing Company,** of Trenton.

The affairs of the **Orr Machine Guarding Company,** of Trenton, which became insolvent a few years ago, have never been wound up. **Assistant District Attorney Joseph Lanigan** is receiver for the concern. The company had liabilities of more than $41,000, with assets of nearly $25,000. The company manufactured metal machine guards.

The following concerns have been incorporated here: **Philadelphia Metal Stamping Company,** Camden, N. J., $50,000. **Manufacturers Electric Plating Company,** Carteret, $125,000. **Sun Engraving Company,** Trenton, $50,000. **Columbia Laboratories, Inc.,** chemicals, Passaic, $100,000 preferred and 1,000 shares common. **H. Baltar Corporation,** Atlantic City, manufacture jewelry, $125,000. **Coppersmiths, Inc.,** metals, Paterson, $100,000. **Walco Wire Devices, Inc.,** Trenton, manufacture electrical devices, $125,000. **Bogota Sheet Metal Works,** metal products, Bogota, $20,000 preferred and 500 shares common. **Mineral and Metal Products Company,** minerals, High Bridge, $125,000.

—C. A. L.

Middle Western States

Detroit, Mich.

October 1, 1929.

Little change has taken place in the non-ferrous metal industries during the last four weeks. There has been no setback and production in all the lines is fair and, it is expected, will be materially increased within the next few weeks, when the winter schedules are started. The motor car industry, which controls this trade in the Detroit area, has slowed up to some extent. But this is only temporary and a condition usually met at this season of the year.

The plating industry is still in fair production and the outlook for the fall and winter is promising.

The Kawneer Company, maker of copper store fronts, show cases and similar products, reports a net profit for the first half year of $273,570 after charges and federal income taxes. The company is experiencing an exceedingly prosperous industrial period.

Next in volume to the sale of coke, the largest single item in revenue-producing by-products at the plants of the **Ford Motor Company** is scrap metal. An average of 28 freight cars daily pull out of the yards loaded with this material, in all about 900 tons, it is stated. Much of this scrap, of course, is iron and steel, but a great quantity of non-ferrous metal is included too.

The Kalamazoo Stove Company, Kalamazoo, Mich., established a new record for shipments in August. The gain was 23 per cent over August a year ago. More orders are now on the company's books than at any time in its history, it is said.

Fire recently destroyed part of the plant of the **United Brass and Aluminum Manufacturing Company,** Port Huron, resulting in damage estimated at $300,000. The building destroyed will be repaired at once.

The Mueller Brass Company, Port Huron, is about to erect a two-story office building. The architect is Walter Wyeth, of Port Huron.

The General Parts Corporation, Flint, Mich., manufacturers of automobile parts and accessories, had net sales for the first six months of 1929 of $783,421, 15 per cent greater than for the corresponding period of 1928.

It is announced by **W. F. Anklam,** president of the **C. M. Hall Lamp Company,** that the company will receive the **Hudson Motor Car Company's** business for the next six months. The first six months of the year showed earnings of approximately $815,000 and the last half is expected to be equally good, according to Mr. Anklam.

According to **George B. Arnold,** factory superintendent, the new airport of the **Buhl Aircraft Company,** located a mile south and a half mile west of St. Clair, Mich., will shortly be in active operation. Construction work on the hangar has been completed. A sprinkler system has been installed to guard against fire.

Announcement is made that the **Detroit Aircraft Corporation** recently purchased a 30-acre tract of land at Long Beach, Calif., for the erection of a large modern airplane factory. According to **E. S. Evans,** president, the company eventually will center in this factory all the activities of its Lockheed division, which is now located at Burbank, near Los Angeles.

McCord Radiator and Manufacturing Company, and its subsidiaries anticipate a net profit for 1929 of more than $1,000,000 as compared with $746,497 for 1928.

Announcement is made that the **Bohn Aluminum and Brass Corporation** will start production of a newly designed connecting rod in December. Those familiar with the new product expect it to equal in volume that of the "Bohnalite" piston, which is said to be one of the biggest factors in the company's rapid growth during the last two years. The new product is only one-third the weight of the cast iron rods now being used on automobile engines.

According to **Edward S. Evans,** preliminary discussions involving the possible construction of four all-metal dirigible aircraft of Zeppelin size and type—two for commercial and two for military use—have been underway between prospective purchasers and the **Detroit Aircraft Corporation.** The contracts, he says, would involve not less than $18,000,000, or $4,500,000 for each ship. Detroit Aircraft, recently leased approximately 50,000 square feet of floor space in the Studebaker plant on Campau Street, Detroit, and will concentrate its executive offices and manufacturing operations there, it is announced by Mr. Evans, who is president of the organization. The old plant has been vacant since the **Studebaker Corporation** moved from it several months ago.

The Campbell, Wyant and Cannon Foundry Company, Muskegon, Mich., reports net income for the first half of 1929 of $1,061,828 after depreciation, interest, and federal taxes, equal to $3.05 a share on 348,000 no-par shares of stock.

The Saginaw Foundries Company, 930 Water Street, Saginaw, recently incorporated with capital stock of $200,000. The company casts bronze and other metals. The owners are **Fred W. Stork, Carl Pletscher** and **H. R. Wickes,** all of Saginaw.

The Wolvering Buff Company, 7415 St. Aubin Avenue, is a new Detroit corporation. It deals in buffing wheels. The owners are **E. E. Janson,** Royal Oak, Mich., and **A. W. Polasky** and **J. C. Woodison** of Detroit.

Landro-Summers Company, 12432 Labrosse Street, Detroit, has been incorporated for the purpose of manufacturing rubbing and polishing compounds. The owners are **Franklin Dechow, Harry W. Summers** and **Donovan W. Stephens,** of Detroit.

The Michigan Brass and Iron Works is now in operation

again at Lansing, after a shutdown following a fire which partially destroyed its plant on July 28. A new shipping room and a rattling room have been erected as an addition to the old plant, which has been repaired. A new building to handle the brass business will be constructed later, it is said. The brass department is now operated as a separate unit.

—F. J. H.

Toledo, Ohio

October 1, 1929.

The non-ferrous metal industry in this area has just about held its own during the last month. No important changes are noted. The outlook is quite encouraging. Production in almost all lines will increase as the fall advances.

The plating industry also has favorable prospects. Increase in production seems assured through the fall and winter. Conditions at present are considerably more favorable than they were a year ago.

Directors of the **J. W. Brown Manufacturing Company,** Detroit, have approved a proposal by the **Electric Auto-Lite Company,** Toledo, for consolidation of the two organizations, it is announced. The consolidation, it is stated, is to be effected by an exchange of stock, the basis being one share of Electric Auto-Lite for two and three-fourth shares of Brown. Consolidation of the two concerns is expected to bring many economies in management and operation. Electric Auto-Lite manufactures starting and lighting systems; the Brown Company is one of the largest manufacturers of automobile lamps in the country.

Closing there of the metal division of **Durant Motors, Inc.,** will remove from Elizabeth, N. J., its last Durant industry. The metal division activities, it is announced, will be taken over by a Toledo, Ohio, concern, and will not be handled directly within the Durant organization. The name of the Toledo concern has not been announced.

—F. J. H.

Cleveland, Ohio

October 1, 1929.

General manufacturing conditions among the metal plants in this area have been only fair within the last few weeks. There seems to be a slow come-back from the summer decline. However, there are indications that production will be resumed on an increased scale before the fall advances very far.

Cleveland, like most of the Great Lakes manufacturing centers, is gradually getting into the airplane industry. The outlook in this field becomes more promising with the advancing months.

Announcement is made that contract to manufacture more than $1,000,000 worth of motor valves for the **Pratt and Whitney Aircraft Company,** Hartford, Conn., has been awarded to **Thompson Products, Inc.,** Cleveland. The contract covers all the valves to be used in Pratt and Whitney "Wasp" and "Hornet" motors for one year, it is stated.

W. L. Fink, metallurgist, declared before the National Metals Congress here early in September, that the x-ray instrument of the physician is becoming a tool of the foundry, and its benefits to the metal industry, of late, have been considerable, notably in aviation. The shadowgraphs of the x-ray machine show shrinkage, blow holes, pin holes, porosity and other imperfections in metals which never could be discovered by other means, he asserted. —F. J. H.

Wisconsin Notes

October 1, 1929.

The metal industry in Wisconsin is enjoying a period of prosperity. This is due to the increased activity in shops and factories throughout the state and to the large amount of building going on.

The Cary Manufacturing Company, formerly of Minneapolis, Minn., will move to Waupaca, taking over the plant of the **Acme Brass Metal Works.** The Cary Manufacturing Company will manufacture oil burners and expects to employ at least 125 men.

The State Supervisor of Illuminating Oils announced that more than 16,000 aluminum placards for displaying the test markings of gasoline have been issued by his department. Every gasoline pump in the state is required to display one of these placards to enable the motorist to know the quality of gasoline that he buys.

—A. P. N.

Other Countries

Birmingham, England

September 20, 1929.

After a quiet period of some two months the non-ferrous rolling mills are becoming more active and look forward hopefully to the Autumn. Non-ferrous tubes are being used to an increasing extent in domestic water conveyance and the dry weather of the season has enabled builders to push forward with great housing schemes so that the demand for brass and copper fitments has been well sustained. The shipbuilding demand for tubes leaves a good deal to be desired. During the last few months work in the shipyards has been on a heavier scale than last year, but orders are being worked off and there is not enough new business coming out to replace all the vessels being launched. Another disturbing influence is the discussion now taking place regarding wage reductions in the shipbuilding and engineering industries. The copper market has been more settled during the last month and some of the brassfounders believe that the improvement in trade in France and the United States will spread to England. The export trade in aluminum hollow-ware so far this year has not reached the level for the same period in 1928.

The new **Tin Producers' Association** announces that the members of the Provisional Council who have accepted membership have now been confirmed as first members of the Permanent Council. The organization and direction of the affairs of the Association will be in the hands of a executive committee which has been elected by the Council and which will be under the independent chairmanship of **Sir William Peat, C. V. O.,** the well-known chartered accountant. It is understood that it will include in addition the following: **C. B. Thomas,** a prominent figure in the Cornish tin mining industry; **Frank Mair,** prominent among British Malayan tin producers; **Temple Harris,** who is identified with some of the most prominent Nigerian producing concerns; **Henry Waugh** of the Taping Malayan group; **Mr. L'Empriere,** representing Australian tin producing interests; **John Howson,** head of the Anglo Oriental and London Malayan groups; **Sir Cyril Butler,** representing production in Siam and Burma; and **Mr. Burn,** head of the Kamunting (Malayan) group. The fact that the executive committee embraces such representative membership is said to indicate that the Association has the support of the British tin industry; and it is also stated that any action taken will have behind it the undivided backing of over 90 per cent of the whole of British tin production.

The Autumn meeting of the **British Institute of Metals** was held at Dusseldorf on September 9 to 12. The eighth Autumn lecture, given by **Dr. H. A. C. Gwyer,** a member of the Council, was entitled **Aluminium and its Alloys** and contained a brief account of some of the more important investigations which have been carried out in recent years upon aluminum and its alloys. A considerable proportion of the lecture included the much discussed heat treatment of aluminum alloys, with a reference to the phenomena of age hardening. Another very interesting paper was given by **Dr. J. Newton Friend** of Birmingham on **The Relative Corrodabilities of Ferrous and Non-Ferrous Metals and Alloys;** Part 2—"The results of Seven Years Exposure to Air at Birmingham." Dr. Friend stated that 54 bars of ferrous and non-ferrous metals were exposed to air on the roof of the **Birmingham Central Technical College**

for seven years and an account was given of the seventeen non-ferrous bars. The metals examined included tin, lead, nickel, zinc, aluminum and various coppers and brasses. All resisted corrosion much more efficiently than the wrought iron and carbon steels. Nickel proved less resistant than copper. Aluminum ranked with lead, tin and stainless steel in offering very high resistance to corrosion. The influence of arsenic on copper was discussed.

In connection with the remarkable resistance of stainless steel to corrosion it is interesting to note that **Brown Bayley and Company** of Sheffield have received an order from the engineers in charge of the preservation work at St. Paul's Cathedral, London, for a chain of stainless steel used as a tie in the dome of the cathedral, the work to be finished early in January. When complete the tie will be even longer than the steel chain made by the same firm for the cathedral last year. The latter was 450 feet long and weighed 30 tons, and it now encircles the outer dome just below the whispering gallery, where it is invisible from the street. It is understood that the rust resisting qualities of the steel have given every satisfaction during the year in which the chain has been in position.

The Birmingham Corporation has set an example to other cities in showing that refuse from its domestic dustbins may be so treated as to become a source of profit, and it is surprising to find that during nine months last year four ounces of gold were recovered from dustbin refuse and were sold for £1 12s. There was even more silver, namely 170 ounces, which realized £12 5s. This was at one salvage depot only. The total amount of refuse dealt with there was 37,736 tons, and apart from gold and silver there were discovered 7 tons brass, one ton lead, two tons aluminum, 1½ tons copper, 2½ tons zinc, 3 hundredweight pewter, two tons spelter, one ton rubber and 92 tons light iron. —J. A. H.

Business Items—Verified

Daniel Cushing, consulting metallurgical engineer, Boston, Mass., has removed from 50 Congress Street to new offices at 148 State Street, same city.

Homer D. Bronson Company, Beacon Falls, Conn., has awarded contracts for a 2 story factory, 35 by 100 ft., for the manufacture of brass goods. The plant will cost $15,000.

Seattle Brass Company, Seattle Wash., will manufacture a valve of new design invented by Thomas Bowler, North Vancouver British Columbia, head of **Bowler Valve, Ltd.,** Vancouver.

The Central Brass and Aluminum Foundry Company, 503 South 21st Street, St. Louis Mo., has finished a new plant addition which makes possible a 50% increase in production. **F. T. O'Hare** is president.

Trumbull Electric Manufacturing Company, Plainville, Conn., affiliated with General Electric Company, plans erection of a new addition to cost $175,000 with equipment, according to **S. S. Gwillim,** secretary.

Montreal Foundry Ltd., brass, aluminum and grey iron founders, have re-incorporated under that name, with capitalization of $199,000. Incorporators are **William Bayliss, Archibald S. Wilson** and **Romeo Leblanc.**

Aero Supply Manufacturing Company, Inc., College Point, Long Island, N. Y., manufacturer of aircraft hardware, has under way a new addition to provide for a 25% increase in production. The addition will cost about $60,000.

Cleveland Armature Works, Inc., 4732 St. Clair Avenue, Cleveland, Ohio, has changed its name to **The Cleveland Armature Works, Inc.** The company manufactures grinders, buffers, polishers and other electrical machinery and equipment.

Perfection Castings, Inc., is the new corporate name of **Smith Wheel, Inc.,** Syracuse N. Y., which has closed the wheel division and concentrated operations in the castings division. The company produces brass, bronze, aluminum and iron castings.

Samson-United Corporation, Rochester, N. Y., has been formed to absorb the business formerly operated under the name **Samson Cutlery Company.** The reorganization, it is stated, insures adequate resources for rapid expansion required by increased sales. No change has been made in the executive staff.

Boston Plating Supply Company, Inc., 191 Haverhill Street, Boston, Mass., manufacturers of equipment and supplies for electroplating and polishing, announce that **Morris Baker** has resigned as president and has been succeeded by **B. F. Lee,** formerly treasurer. Mr. Baker is replaced on the board of directors by **A. W. Collins.**

C. G. Conn Company, Elkhart, Ind., **Ludwig and Ludwig,** Chicago, Ill., and **Leedy Manufacturing Company,** Indianapolis, Ind., band instrument manufacturers, have merged. Reports that **Beuschler Band Instrument Company,** Elkhart, Ind., had also been included in the plans for this merger are corrected by **O. E. Beers,** general manager, who states that the company has not thus far entered into any merger proposals.

Rensselaer Valve Company, Troy, N. Y., is installing Norblo dust collecting equipment in the cleaning department, it is announced. Similar equipment is also being installed by the **Crucible Steel Casting Company,** Lansdowne, Pa., in its foundry sand reclaiming department, and by the **Florence Pipe and Foundry Company,** Florence, N. J., in its cleaning department.

J. B. Ripley Brass Foundry, Inc., Windsor, Vt., has moved into its new plant north of Coolidge Court, where it has a new 40 by 140 ft. fireproof, concrete and steel foundry. The company's present capacity is 4 tons of finished castings daily. According to **J. B. Ripley,** president, business is coming in in good volume. Provision has been made for future plant expansion.

Federal Electric Company, 8700 South State Street, Chicago, Ill., has concluded arrangements for purchase of and consolidation with the **Loper Fire Alarm Company,** Stonington, Conn. It is proposed to remove the Loper plant to Chicago, where production would be increased. **A. P. Loper,** former head of the Loper firm, will continue as consulting engineer with the Federal company.

Wagner Electric Corporation, 6400 Plymouth Avenue, St. Louis, Mo., has opened a new branch sales office at 734 Allen Building, Dallas, Texas, in charge of **Alfred B. Emrick,** formerly in charge of the company's Pittsburgh office. The Wagner company has appointed **James G. Pattillo,** Jr., manager of the Pittsburgh branch sales office. **Ralph** R. **Rugheimer** has been made a member of the sales staff at the Atlanta, Ga., branch sales office.

The Roxalin Flexible Lacquer Company, Inc., has recently opened a branch office at 230 East Ohio Street, Chicago, Illinois. Milford H. Corbin, who has been associated with their technical staff, is in charge. This branch will render a full technical service to middle western accounts and in addition, will be in a position to offer excellent deliveries on Roxalin standard items which will be conveniently warehoused in Chicago.

Chromium Engineering Corporation of America, 132-134 West 22nd Street, New York City, has established a complete modern job shop at that address, with all facilities for every branch of electroplating. The company has also opened there a complete laboratory for chemical analysis. The new plant cost $30,000 with equipment. **James L. Garde** will be in charge of the shop. The laboratory will have twelve chemical engineers, with **Otto H. Loven,** formerly with the Bassick Company, Bridgeport, Conn., in charge.

I. Fischman and Sons, Inc., Tenth Street and Allegheny Avenue, Philadelphia, Pa., will consolidate its three soda fountain equipment plants in a new two- and three-story plant on Erie Avenue, from F to G Streets, including the former plant of the Stanley H. Knight Company, 216 West Superior Street, Chicago Ill., recently acquired. The new plant, providing about four times the present floor space, cost about $1,500,000 with equipment. Maurice Fischman heads the company. Non-ferrous foundries, machine shops, casting shop, plating, polishing and grinding departments, etc., are operated.

Review of the Wrought Metal Business

By J. J. WHITEHEAD
President of the Whitehead Metal Products Co. of New York, Inc.

WRITTEN ESPECIALLY FOR THE METAL INDUSTRY

OCTOBER 1, 1929.

The increase in the demand for copper after a period of stagnation since the spring, began making itself felt about August 1st. There was a spirit of foreign buying for about ten days and then the demand tapered off somewhat and remained quiescent till about the twentieth of August, when it started again and continued till about the tenth of September. During this period of about twenty days, tremendous tonnages of copper were bought for immediate delivery and for delivery during October. At one time early in September it was common gossip that the domestic price of copper was going to 18¼c, with a corresponding increase in the price of the metal for export. However, the producers, who could easily have increased the price, justified themselves by holding to the 18c level, which they maintained during the preceding three months, when there was no copper of any amount purchased.

It is expected that the copper statistics for the month of September and which are issued about the 15th of October will be favorable.

After a three-month lull in buying, it was only natural that brass mills should be slowing down on September 1st. The recent buying wave, however, has changed this so that the mills are busier than ever and have more orders on their books, probably, than at any time in their history.

The demand for copper wire is especially great and additional manufacturing facilities, if available, could be profitably employed. There is no indication that the demand for wire is slackening; if anything, the needs of consumers are on the increase. Users of copper and brass products have purchased some of their requirements but will undoubtedly have to come into the market again toward the end of October, provided other conditions remain normal.

There is one thing that the consumers of copper will note: there was metal available at 18c even when the demand was acute. Following the spring the price was 18c even when there was no demand of any consequence. It would seem logical, therefore, that instead of waiting till everyone needs metal and then all scrambling at the same time, it might be well to form a buying policy of covering metal requirements from "day to day," as it were. This point is well worth considering. Certainly the metal trade generally ought to congratulate the producers on the excellent way in which they are handling the situation by keeping the market stabilized instead of having it fluctuate violently up and down.

The demand for nickel is holding up and is on the increase. The use of nickel for alloying with iron and steel and with copper has created a situation where there is no limit to the amount of nickel that may be used. We are entering into the so-called "rustless" age, and nickel is at the present time absolutely necessary for producing the ferrous alloys that will resist rust. It is believed that users of nickel in any form should keep their requirements well covered.

There seems to be a slight let up in the demand for Monel metal, which is to be expected. However, it is not to be inferred that requirements for all shapes and various kinds of products can be filled immediately, the leading sellers of this metal declare. They advise users to anticipate to some extent what they need, if possible.

A slight slackening of business generally has been noted. Building has fallen off some. Whether this slackening is just another lull before further extensive fall activity remains to be seen. The month of October usually settles this question. It is significant that at the moment railroads are making tremendous purchases of steel and other commodities.

Metal Market Review

By R. J. HOUSTON
D. Houston and Company, Metal Brokers, New York

WRITTEN ESPECIALLY FOR THE METAL INDUSTRY

COPPER

OCTOBER 1, 1929.

Exceptional market activity characterized the movements in copper for the month of September. Sales reached a record volume in the first half of the month. Total transactions for a single week ending in early September were estimated at 102,000 tons on domestic account alone. Export business was also of heavy proportions.

Throughout a period of many weeks during the summer domestic demand was of a hand-to-mouth nature. All that time, however, there was no deviation by producers from the 18-cent price level. The soundness and strength of the situation was therefore clearly demonstrated. There was consequently no ground to expect price concessions, and when buyers at home and abroad realized that fact there was a feverish haste by consumers to cover requirements.

The strong revival in buying gave the market a well defined trend, and for a time it looked as if higher prices would be established. It was significant that one prominent interest raised the domestic quotation to 18¼ cents, but the same seller was soon back to the 18-cent level. Following recent enormous business, intense demand has subsided. August copper statistics showed a large gain in surplus stocks of refined metal. Output shows curtailment each successive month since May. Domestic deliveries are good, but exports of less than 50,000 tons a month are disappointing. Refined stocks are nearly double what they were April 1. An increase of almost 100% in five months shows how quickly the status of the industry can be changed.

ZINC

The supply situation in zinc is ample, with demand steady enough to keep the market on the basis of 6.75c to 6.80c generally delivered at the East St. Louis terms. Production schedules are maintained above outlet channels, and statistics show that further curtailment is needed to cut down the floating supply. Smelters' stocks of slab zinc on September 1 were 47,833 tons, an increase for the month of 3,711 tons. Zinc prices are about the highest this year, and compare with a high last year of 6.35c East St. Louis basis.

TIN

Evidences are accumulating that go to show that pig tin is no longer the highly speculative and erratic metal it once was. There are probably several reasons why the market for this article has lost its dynamic intensity, but one is that the speculative public is able to get more of a thrill out of the stock market than is possible in tin or any of the metals. Factors in tin have always been wide and rapid fluctuations. Conditions in London and New York, however, have changed, and despite the growth and expansion in production and consumption market movements are no longer as spectacular or price changes as violent as formerly.

Fluctuations in prices during September ranged between 44⅞c and 45⅞c for prompt Straits tin, the low figure being quoted near the close of the month. In 1928 the quotational extremes for the year were 45¾c and 57¼, in 1927 the low point was 56⅛c and the high 71c, in 1926 a low of 58½c and a high of 72½c were recorded.

These wide price divergencies kept the speculative interest in tin keyed up to a high pitch, and successful operators were able to reap huge profits.

Conditions have changed and tin values must now be governed by the same forces that influence markets for other commodities, namely, by economic and natural values based on the up and down movements of supply and demand. Consumers cannot carry on operations normally when their raw material, on which they depend, shows a spread of 12c to 14c a pound annually, as was the case with tin during the last three years. The high price of prompt Straits this year was 50⅜c and the low 43⅜c, a variation of 7 cents a pound. The tendency towards price stabilization has been more apparent lately, and the price fluctuation for prompt Straits tin in September was only one per cent per pound.

LEAD

Business developed at a brisk rate in the first half of September, and demand was of large proportions. Prices were advanced early in the month to 6.70c East St. Louis and 6.90c New York, and all positions available were freely purchased. Consumers covered October requirements on the new basis, and a heavy demand for November is expected to give new impetus to the market. There was an active call for prompt shipments covering a large tonnage, and the situation gave substantial evidence of firmness at the month-end. World output of lead for August showed a decrease of 2,843 tons compared with the figures for July. Domestic and Mexican production lately has also been curtailed. This feature leads the trade to watch the situation closely.

ALUMINUM

Consumption of aluminum continues heavy, although demand at present from the automobile industry is less active. Other industries, however, were reported taking a larger proportion of the metal than a year ago. The world production seems to be on an expanding scale, but this appears necessary to meet the growing requirements of consumption. The aviation industry, radio makers and the aluminum furniture business are important factors in creating new demand. Prices continue firm and unchanged.

ANTIMONY

Market movements in antimony lately were within narrow compass. Steadiness was the prevailing feature, with indications that price would give way under pressure to sell. Demand was only moderate, but reported disturbances in China tended to keep prices steady at 8⅝c for prompt delivery duty paid. This figure might be shaded for fourth quarter arrivals.

QUICKSILVER

Recent business in quicksilver was confined to limited quantities Prices remain steady at $124.50 to $125 per flask of 76 pounds.

PLATINUM

Refined platinum is quoted at $61.50 to $62 per ounce. The principal demand for platinum comes from the jewelry trade, with the electrical industry the second in magnitude and the chemical industry ranking as the third largest user. Russia, Colombia and South Africa are the largest producers.

SILVER

Conditions in the silver market show no improvement, and the trend recently has been downward. The New York price on September 30 touched the low level of 50 cents an ounce. Weakness in China exchanges and heavy sales by Chinese speculators contributed to the downward movement. India also operated on a moderate scale both ways lately. Producers feel the consequences of the steady falling off in market values. This feature should tend to lessen output until demand is able to absorb larger quantities at decidedly higher prices. Silver stocks in Shanghai on September 19 totaled 189,139,000 taels, being an increase over the previous week.

OLD METALS

Demand for secondary copper held up good during the past month. Consumers and refineries were buyers of substantial tonnages. Exporters also displayed quite satisfactory interest and the movement for foreign shipment was in good volume. No accumulation of the better grades of heavy copper and wire is heard of, and consumers have been taking this grade of material freely. Market was steady at close of month, but the turnover was not quite so active as a few weeks ago. There was a fairly good demand for lead scrap and other grades. The price basis dealers named on purchases were 15½c to 15¾c for crucible copper, 14¾c to 15c for heavy copper and wire, 12¾c to 13c for light copper, 8¼c to 8½c for heavy brass, 11¼c to 11½c for new brass clippings, 4¾c to 5c for heavy lead, and 17¼c to 18c for aluminum clippings.

Daily Metal Prices for the Month of September, 1929

Record of Daily, Highest, Lowest and Average Prices and the Customs Duties

	2*	3	4	5	6	9	10	11	12	13	16	17
Copper c/lb. Duty Free												
Lake (Del.)	.....	18.25	18.375	18.375	18.375	18.375	18.25	18.25	18.125	18.125	18.125	18.125
Electrolytic (f. a. s. N. Y.)	.....	18.25	18.25	18.25	18.25	18.25	18.25	18.25	18.00	18.00	18.00	18.00
Casting (f. o. b. N. Y.)	.....	17.875	17.875	17.875	17.875	17.875	17.875	17.875	17.75	17.75	17.75	17.75
Zinc (f. o. b. St. L.) c/lb. Duty 1¾c/lb.												
Prime Western	.....	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80
Brass Special	.....	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90
Tin (f. o. b. N. Y.) c/lb. Duty Free.												
Straits	.....	45.625	45.875	45.75	45.625	45.50	45.375	45.375	45.375	45.375	45.50	45.25
Pig 99%	.....	45.00	45.25	45.00	44.875	44.75	44.625	44.625	44.625	44.625	44.875	44.625
Lead (f. o. b. St. L.) c/lb. Duty 2⅛c/lb.	.....	6.55	6.60	6.70	6.70	6.70	6.70	6.70	6.70	6.70	6.70	6.70
Aluminum c/lb. Duty 5c/lb.	.....	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30
Nickel c/lb. Duty 3c/lb.												
Ingot	.....	35	35	35	35	35	35	35	35	35	35	35
Shot	.....	36	36	36	36	36	36	36	36	36	36	36
Electrolytic	.....	35	35	35	35	35	35	35	35	35	35	35
Antimony (J. & Ch.) c/lb. Duty 2c/lb.	.....	8.75	8.75	8.75	8.75	8.65	8.75	8.85	8.85	8.75	8.70	8.70
Silver :/oz. Troy Duty Free	.....	52.125	52.25	52.125	51.75	51.75	51.625	51.625	51.625	50.875	50.625	50.75
Platinum $/oz. Troy Duty Free	.....	62.50	62.50	62.50	62.50	62.50	62.50	62.50	62.50	62.50	62.50	62.50

	18	19	20	23	24	25	26	27	30	High	Low	Aver.
Copper c/lb. Duty Free												
Lake (Del.)	18.125	18.125	18.125	18.125	18.125	18.125	18.125	18.125	18.125	18.375	18.125	18.194
Electrolytic (f. a. s. N. Y.)	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.25	18.00	18.088
Casting (f. o. b. N. Y.)	17.75	17.75	17.75	17.75	17.75	17.75	17.75	17.75	17.75	17.875	17.75	17.794
Zinc (f. o. b. St. L.) c/lb. Duty 1¾c/lb.												
Prime Western	6.80	6.80	6.775	6.775	6.80	6.80	6.80	6.80	6.80	6.80	6.775	6.798
Brass Special	6.90	6.90	6.875	6.875	6.90	6.90	6.90	6.90	6.90	6.90	6.875	6.898
Tin (f. o. b. N. Y.) c/lb. Duty Free												
Straits	45.125	45.375	45.50	45.375	45.25	45.125	45.00	45.15	45.00	45.875	45.00	45.376
Pig 99%	44.50	44.75	44.875	44.75	44.65	44.50	44.375	44.50	44.25	45.25	44.25	44.701
Lead (f. o. b. St. L.) c/lb. Duty 2⅛c/lb.	6.70	6.70	6.70	6.70	6.70	6.70	6.70	6.70	6.70	6.70	6.55	6.688
Aluminum c/lb Duty 5c/lb.	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30	24.30
Nickel c/lb. Duty 3c/lb.												
Ingot	35	35	35	35	35	35	35	35	35	35	35	35
Shot	36	36	36	36	36	36	36	36	36	36	36	36
Electrolytic	35	35	35	35	35	35	35	35	35	35	35	35
Antimony (J. & Ch.) c/lb. Duty 2c/lb.	8.70	8.70	8.70	8.70	8.70	8.625	8.625	8.625	8.50	8.85	8.50	8.706
Silver c/oz. Troy Duty Free	50.375	50.50	50.625	50.50	50.625	51.00	50.75	50.125	50.00	52.25	50.00	51.081
Platinum $/oz. Troy Duty Free	62.50	62.50	62.00	62.00	62.00	62.00	62.00	62.00	62.00	62.50	62.00	62.325

*Holiday.

Metal Prices, October 7, 1929

NEW METALS

Copper: Lake 18.125. Electrolytic 18.00. Casting, 17.50.
Zinc: Prime Western, 6.80. Brass Special, 6.85.
Tin: Straits, 43.875. Pig, 99%, 43.25.
Lead: 6.70. **Aluminum,** 24.30 **Antimony,** 8.50.

Nickel: Ingot, 35. Shot, 36. Elec., 35. Pellets, 40.
Quicksilver: flask, 75 lbs., $125. **Bismuth,** $1.70.
Cadmium, 95. **Cobalt,** 97%, $2.60. **Silver,** oz., Troy, 50.00.
Gold: oz., Troy, $20.67. **Platinum,** oz., Troy, $62.00.

INGOT METALS AND ALLOYS

Brass Ingots, Yellow	12¾to14
Brass Ingots, Red	15¾to16¾
Bronze Ingots	16¾to20
Casting Aluminum Alloys	21 to24
Manganese Bronze Castings	27 to39
Manganese Bronze Ingots	15 to20
Manganese Bronze Forging	35 to43
Manganese Copper, 30%	30 to40
Monel Metal Shot	28
Monel Metal Blocks	28
Parsons Manganese Bronze Ingots	16½to19¾
Phosphor Bronze	17 to21
Phosphor Copper, guaranteed 15%	21½to25
Phosphor Copper, guaranteed 10%	20½to24
Phosphor Tin, no guarantee	51 to65
Silicon Copper, 10%, according to quantity	30 to35

OLD METALS

Buying Prices		Selling Prices
15⅜to15½	Heavy Cut Copper	16⅜to16½
14⅛to14⅝	Copper Wire, mixed	15⅛to15⅝
12½to13½	Light Copper	13½to14½
12 to12½	Heavy Machine Composition	13 to13½
8¼to 9	Heavy Brass	9¼to10
7 to 7½	Light Brass	8 to 8½
9½to10	No. 1 Rod Brass Turnings	10½to11
11¼to11¾	Composition Turnings	12¼to12¾
5⅜to 5⅝	Heavy Lead	6⅛to 6⅜
3¼to 3¾	Zinc Scrap	4¼to 4¾
8 to 8½	Scrap Aluminum Turnings	12 to12½
11½to12	Scrap Aluminum, cast alloyed	15½to16
17 to18	Scrap Aluminum sheet (new)	20 to21
31 to33	No. 1 Pewter	36 to39
20 to21	Old Nickel Anodes	22 to23
20 to23	Old Nickel	22 to25

Wrought Metals and Alloys

COPPER SHEET

Mill shipment (hot rolled) ....27¾c. to 28¾c. net base
From Stock ....28¾c. to 29¾c. net base

BARE COPPER WIRE

19⅝c. to 19⅞c. net base, in carload lots.

COPPER SEAMLESS TUBING

29¼c. to 30¼c., net base.

SOLDERING COPPERS

300 lbs. and over in one order ....26¼c. net base
100 lbs. to 200 lbs. in one order ....26¾c. net base

ZINC SHEET

Duty on sheet, 2c., per pound	Cents per lb.
Carload lots, standard sizes and gauges, at mill, less 7 per cent discount	10.50 net base
Casks, jobbers' price	10.75 net base
Open casks, jobbers' price	11.25to11.75 net base

ALUMINUM SHEET AND COIL

Aluminum sheet, 18 ga., base price, ton lots...............33.30c.
Aluminum coils, 24 ga., base price, ton lots...............31.00c.

ROLLED NICKEL SHEET AND ROD

Net Base Prices

Cold Drawn Rods	53c.	Cold Rolled Sheet	60c.
Hot Rolled Rods	45c.	Full Finished Sheet	52c.

BLOCK TIN SHEET

Block Tin Sheet—18" wide or less. No. 26 B. & S. Gauge or thicker, 100 lbs. or more 10½c. over Pig Tin; 50 to 100 lbs., 15c. over; 25 to 50 lbs., 17c. over; less than 25 lbs., 25c. over.

SILVER SHEET

Rolled sterling silver 51.50 c. per ounce, Troy upward, according to quantity.

BRASS MATERIAL—MILL SHIPMENTS

In effect April 16, 1929
To customers who buy 5,000 lbs. or more in one order.

	Net base per lb.		
	High Brass	Low Brass	Bronze
Sheet	$0.23¼	$0.25	$0.26¼
Wire	.23¾	.25½	.26¾
Rod	.21¼	.25¾	.27
Brazed tubing	.30⅞	....	.35⅞
Open seam tubing	.31¼	....	.34¼
Angles and channels	.31¼	....	.34¼

BRASS SEAMLESS TUBING

28¼c. to 29¼c. net base.

TOBIN BRONZE AND MUNTZ METAL

Tobin Bronze Rod	25¼c. net base
Muntz or Yellow Metal Sheathing (14"x48")	24c. net base
Muntz or Yellow Rectangular sheet other Sheathing	25c. net base
Muntz or Yellow Metal Rod	22¼c. net base

Above are for 100 lbs. or more in one order.

NICKEL SILVER (NICKELENE)

Net Base Prices

Grade "A" Sheet Metal		Wire and Rod	
10% Quality	31⅛c.	10% Quality	34⅛c.
15% Quality	33c.	15% Quality	37¾c.
18% Quality	34¼c.	18% Quality	41c.

MONEL METAL, SHEET AND ROD

Hot Rolled Rods (base)	35	Full Finished Sheets (base)	42
Cold Drawn Rods (base)	40	Cold Rolled Sheets (base)	50

BRITANNIA METAL SHEET

No. 1 Britannia—18" wide or less, No. 26 B. & S. Gauge or thicker, 500 lbs. or over, 8c. over N. Y. tin price; 100 lbs. to 500 lbs., 10c. over; 50 to 100 lbs., 15c. over; 25 to 50 lbs., 20c. over; less than 25 lbs. 25c. over. Prices f. o. b. mill.

Supply Prices, October 7, 1929

ANODES

Copper: Cast	28c.	per lb.
Rolled, oval	27c.	per lb.
Rolled, sheets, trimmed	27¼c.	per lb.
Brass: Cast	27c.	per lb.
Zinc: Cast	12½c.	per lb.
Nickel: 90-92%	45c.	per lb.
95-97%	47c.	per lb.
99%	49c.	per lb.

Silver: Rolled silver anodes .999 fine are quoted from 53c., Troy ounce, upward, depending upon quantity.

FELT POLISHING WHEELS WHITE SPANISH

Diameter	Thickness	Under 100 lbs.	100 to 200 lbs.	Over 200 lbs
10-12-14 & 16"	1" to 3"	$3.00/lb.	$2.75/lb.	$2.65/lb.
6-8 & Over 16	1 to 3	3.10	2.85	2.75
6 to 24	Under ½	4.25	4.00	3.90
6 to 24	½ to 1	4.00	3.75	3.65
6 to 24	Over 3	3.40	3.15	3.05
4 up to 6	¼ to 3	4.85	4.85	4.85
4 up to 6	Over 3	5.25	5.25	5.25
Under 4	¼ to 3	5.45	5.45	5.45
Under 4	Over 3	5.85	5.85	5.85

Grey Mexican Wheel deduct 10c per lb. from White Spanish prices.

COTTON BUFFS

Full Disc Open buffs, per 100 sections.

12" 20 ply 64/28 Unbleached	$28.27 to $28.30
14" 20 ply 64/68 Unbleached	36.45 to 37.34
12" 20 ply 80/92 Unbleached	31.25 to 34.16
14" 20 ply 80/92 Unbleached	42.40 to 46.09
12" 20 ply 84/92 Unbleached	36.60 to 42.90
14" 20 ply 84/92 Unbleached	49.60 to 57.60
12" 20 ply 80/84 Unbleached	38.35 to 39.37
14" 20 ply 80/84 Unbleached	52.00 to 53.12

Sewed Pieced Buffs, per lb., bleached .... 52c. to 71c.

CHEMICALS

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone	lb.	.14-.20
Acid—Boric (Boracic) Crystals	lb.	.08½
Chromic, 75 to 400 lb. drums	lb.	.19
Hydrochloric (Muriatic) Tech., 20°, Carboys	lb.	.03
Hydrochloric, C. P., 20 deg., carboys	lb.	.06
Hydrofluoric, 30%, bbls.	lb.	.08
Nitric, 36 deg., carboys	lb.	.06
Nitric, 42 deg., carboys	lb.	.07
Sulphuric, 66 deg., carboys	lb.	.03
Alcohol—Butyl	lb.	.16¾-.21¼
Denatured, drums	gal.	.50-.60
Alum—Lump, Barrels	lb.	.0385
Powdered, Barrels	lb.	.039
Aluminum sulphate, commercial tech.	lb.	3.3
Aluminum chloride, solution in carboys	lb.	.06½
Aluminum—Sulphate, tech., bbls.	lb.	.33
Sulhpocyanide	lb.	.65
Arsenic, white, kegs	lb.	.05
Asphaltum	lb.	.35
Benzol, pure	gal.	.60
Borax Crystals (Sodium Biborate), bbls.	lb.	.04½
Calcium Carbonate (Precipitated Chalk)	lb.	.04
Carbon Bisulphide, Drums	lb.	.06
Chrome Green, bbls.	lb.	.29
Chromic Sulphate	lb.	.30-.50
Copper—Acetate (Verdigris)	lb.	.25
Carbonate, bbls.	lb.	.21½
Cyanide (100 lb. kgs)	lb.	.45
Sulphate, bbls.	lb.	6.7
Cream of Tartar Crystals (Potassium Bitartrate)	lb.	.27
Crocus	lb.	.15
Dextrin	lb.	.05-.08
Emery Flour	lb.	.06
Flint, powdered	ton	$30.00
Fluor-spar (Calcic fluoride)	ton	$70.00
Fusel Oil	gal.	$4.45
Gold Chloride	oz.	$14.00
Gum—Sandarac	lb.	.26
Shellac	lb.	.59-.61
Iron Sulphate (Copperas), bbl.	lb.	.01½
Lead Acetate (Sugar of Lead)	lb.	.13¾
Yellow Oxide (Litharge)	lb.	.12½
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Nickel—Carbonate, dry bbls.	lb.	.35
Chloride, bbls.	lb.	.21½
Salts, single, 300 lb. bbls.	lb.	.13
Salts, double, 425 lb. bbls.	lb.	.13
Paraffin	lb.	.05-.06
Phosphorus—Duty free, according to quantity	lb.	.35-.40
Potash, Caustic Electrolytic 88-92% broken, drums	lb.	.083
Potassium Bichromate, casks (crystals)	lb.	.09¼
Carbonate, 96-98%	lb.	.06¾-.07
Cyanide, 165 lb. cases, 94-96%	lb.	.57½
Pumice, ground, bbls.	lb.	.02½
Quartz, powdered	ton	$30.00
Rosin, bbls.	lb.	.04½
Rouge, nickel, 100 lb. lots	lb.	.25
Silver and Gold	lb.	.65
Sal Ammoniac (Ammonium Chloride) in casks	lb.	.05½
Silver Chloride, dry, 100 oz. lots	oz.	.41
Cyanide (fluctuating)	oz.	.50½
Nitrate, 100 ounce lots	oz.	.35¼
Soda Ash, 58%, bbls.	lb.	.02½
Sodium—Cyanide, 96 to 98%, 100 lbs.	lb.	.18
Hyposulphite, kegs	lb.	.04
Nitrate, tech., bbls.	lb.	.04¾
Phosphate, tech., bbls.	lb.	.03¾
Silicate (Water Glass), bbls.	lb.	.02
Sulpho Cyanide	lb.	.32½
Sulphur (Brimstone), bbls.	lb.	.02
Tin Chloride, 100 lb. kegs	lb.	.37
Tripoli, Powdered	lb.	.03
Wax—Bees, white, ref. bleached	lb.	.60
Yellow, No. 1	lb.	.45
Whiting, Bolted	lb.	.02½-.06
Zinc, Carbonate, bbls.	lb.	.11
Chloride, casks	lb.	.06¼
Cyanide (100 lb. kegs)	lb.	.41
Sulphate, bbls.	lb.	.03½